The Electrical Industry's Weekly Magazine

December 23, 1957

Electrical World

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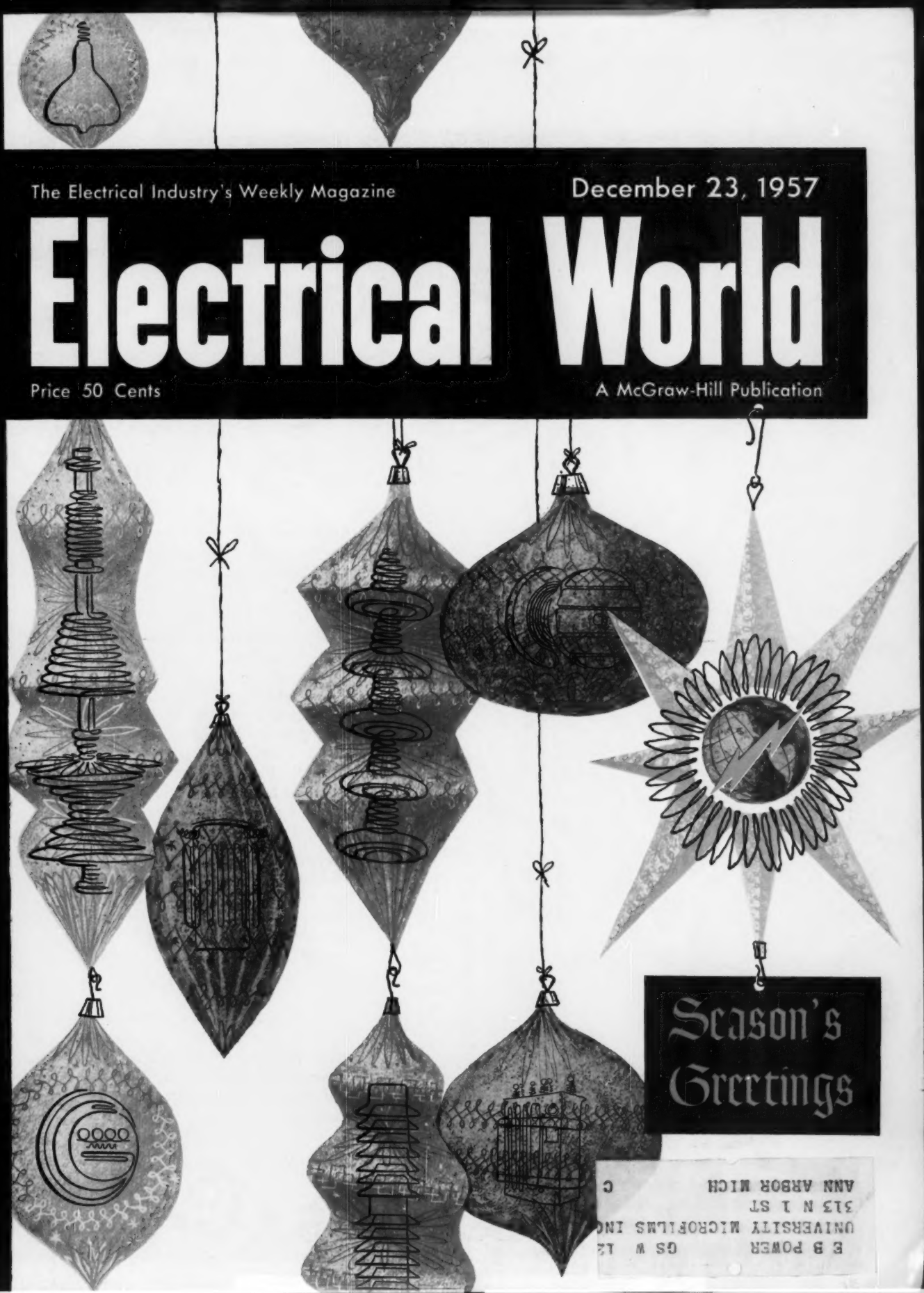

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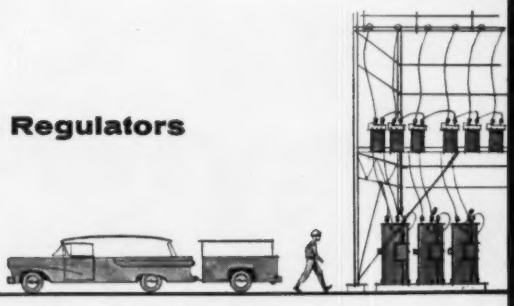
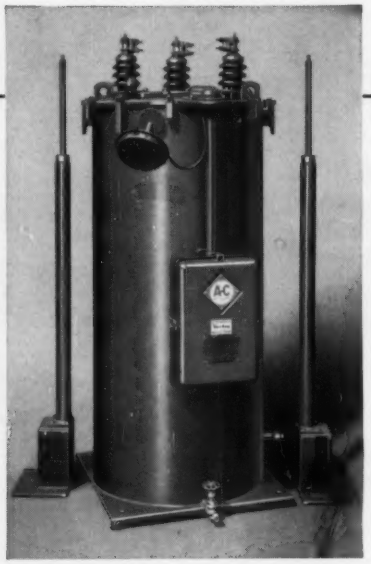
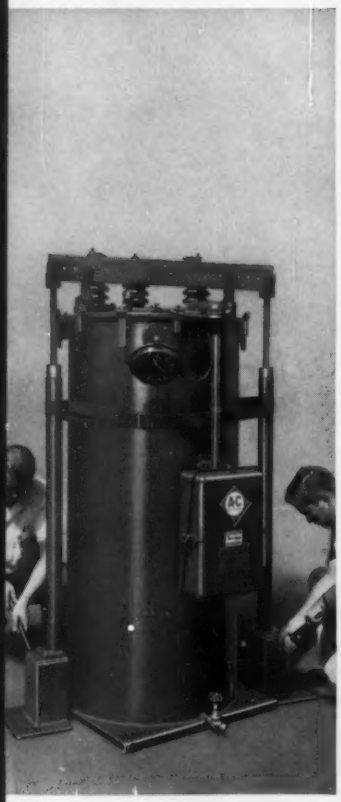
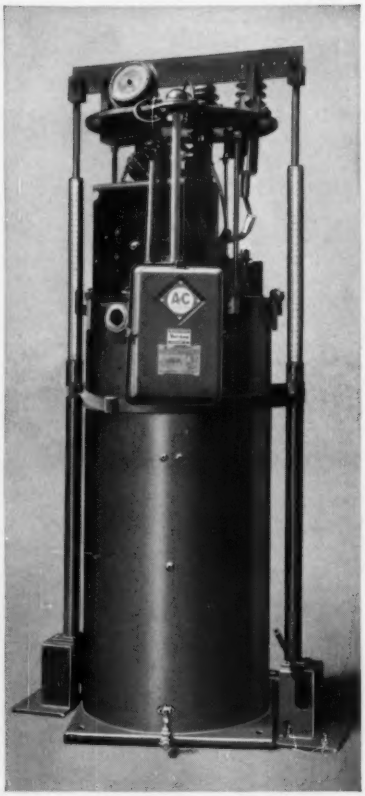
Allis-Chalmers – Originators of 5/8% Step Regulators









Get "On-the-Site" Inspection with Unit Construction

Allis-Chalmers unit construction means the transformer and tap-changing mechanism are suspended from the cover. This assures these advantages:

Easy servicing — Piecemeal inspection is eliminated by unit construction and cover suspension. There's no need to drain oil, remove bushings or control leads, or move the regulator. Field inspection is further simplified with inspection jacks which are used, as shown in photos at left, to raise mechanism high enough to permit servicing on-the-spot.

Superior workmanship — All connections during manufacturing are made out in the open before the unit is tanked. Entire operating mechanism and control can be inspected and operated while untanked.

* * *

For details of these and other advantages of Allis-Chalmers regulators, call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-5587

Electrical World

Vol. 148, No. 26 December 23, 1957

Published for 83 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

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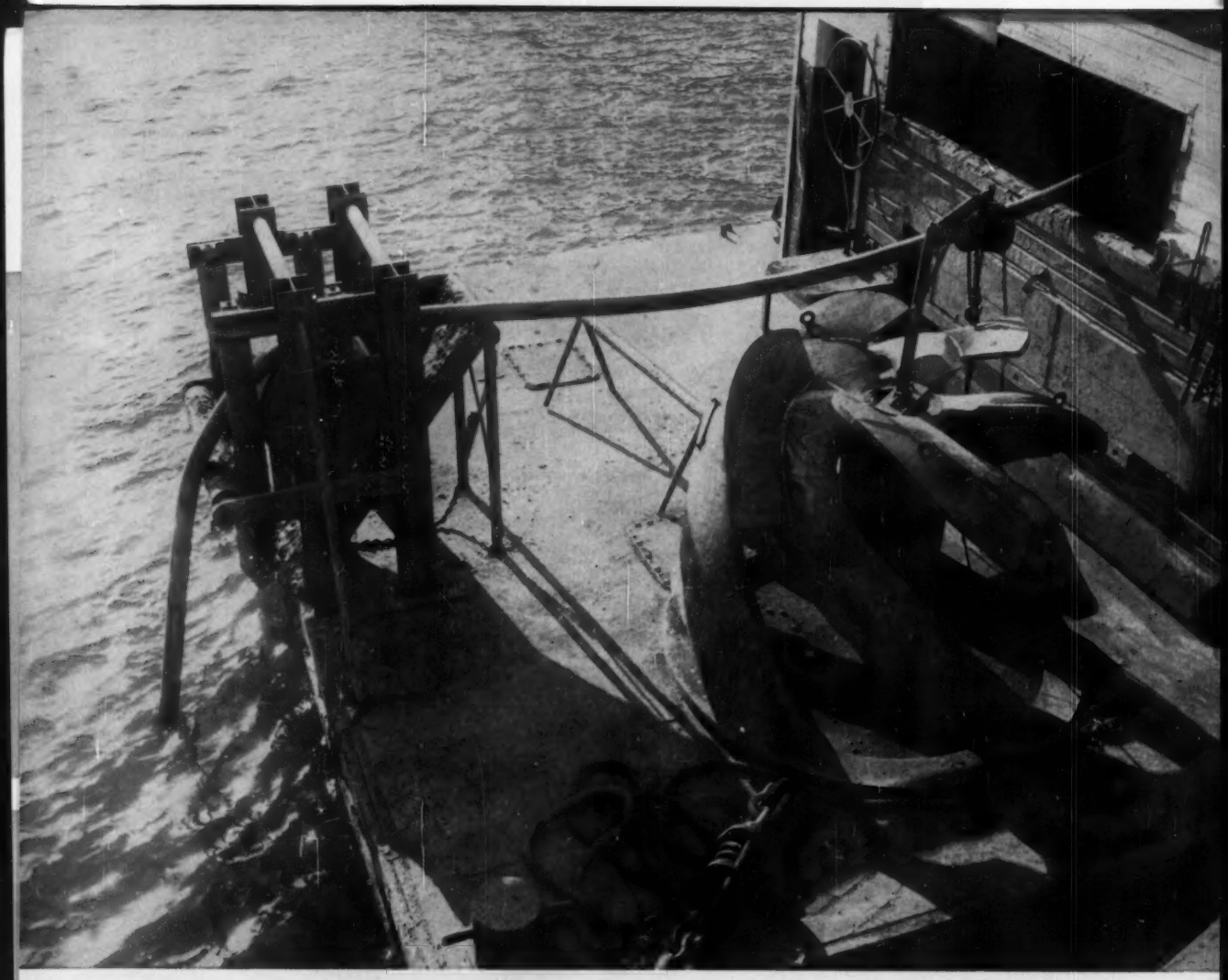

Built for a long life of hard knocks, this 4,500-foot, 3-phase, 20kv, shielded Okolite insulated cable with Okoprene sheath powers the rotary cutter head ... right. Although nearly 5 inches thick, this cable has all the flexibility needed for dredging operations.

the previous OKONITE cable lasted 15 years ...but this one is built for even better service

Pacific Dredging Company has recently put into service an Okonite replacement for an Okonite 15kv armored cable that had seen fifteen years of successful service . . . two to three times normal expectancy. In the strenuous operation of cables feeding power to giant dredges from shore stations, five years' service life is considered good.

But the new cable was designed to last even longer than its predecessor. The major cause of breakdown in dredging cables has been deterioration of the armor wire, which breaks and punctures the insulation. To overcome this, Okonite engineers replaced the armor with a tough, mold-cured, reinforced Okoprene sheath. Although this construction has only been in operation for a year, Pacific Dredging Company is confident that it will outperform the old one.

This example of Okonite's constant determination to "better the best" shows why Okonite has always been considered a leader in developing and building the finest cables available. Do you have a cable problem? There's a good chance that Okonite engineers have already solved it. Find out today. The Okonite Co., Passaic, N.J.

4349

where there's electrical power . . . there's **OKONITE CABLE**

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. . . from the publisher

Thank You, Everyone

As the day of Christmas approaches, we at Electrical World send our grateful good wishes to each of you. We most sincerely thank you for your substantial part in making the industry's magazine more useful and more interesting.

Your countless contributions during the year have come in many forms:

Some of you have stayed up nights writing thoughtful and informative articles, performing a real service for the whole industry.

Many of you have given valuable hours answering the endless questions of our survey interviewers and our editors.

Others of you have patiently answered the questionnaires that we have sent to you on industry problems.

From others of you have come valuable tips which led to our best and most timely stories of the year.

Many of you have advised us in difficult technical areas on our editorial policies and service to our readers.

And each of you has given us your full cooperation in building and carrying on a magazine whose main purpose is to serve you.

To every one of you we express our deepest appreciation and we extend our hopes for a joyous Christmas Season.

Fischer Black

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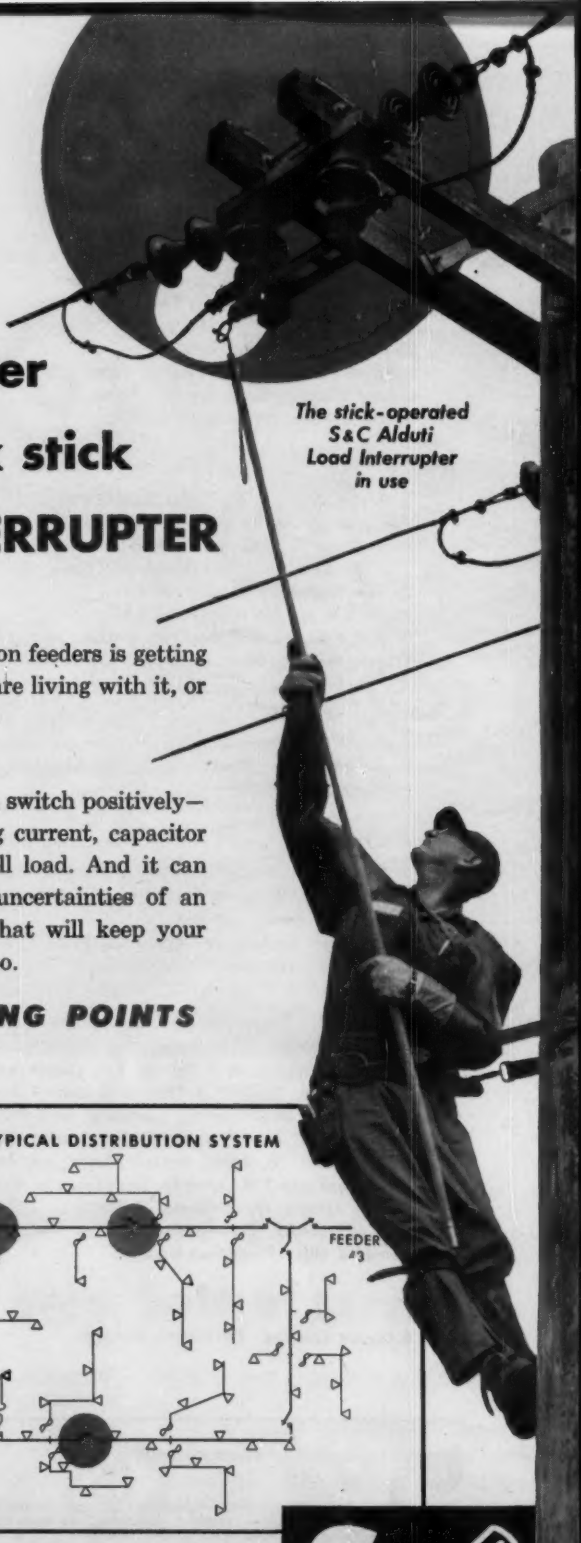
Postmaster . . . Please send form 3579 to Electrical World, 330 W. 42nd St., New York 36, N. Y.

he can switch your 12 kv feeders anywhere, any time, under any load with a hook stick using an S&C LOAD INTERRUPTER



The stick-operated S&C Alduti Load Interrupter in use

Sure! The switching of your 12 kv distribution feeders is getting tougher and tougher! Maybe your linemen are living with it, or maybe you are spending a fortune just to get by.

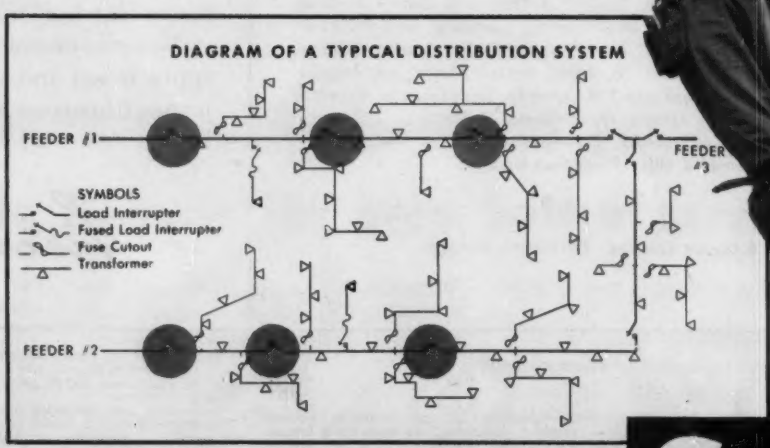
Is there another alternative?

Certainly! A stick-operated S&C Load Interrupter. It can switch positively—under any condition—any load, whether it's line charging current, capacitor charging current, magnetizing current, or full load. And it can be done without the hazards and uncertainties of an external arc. Here's a switch that will keep your linemen happy, and the comptroller, too.

USE IT AT SECTIONALIZING POINTS

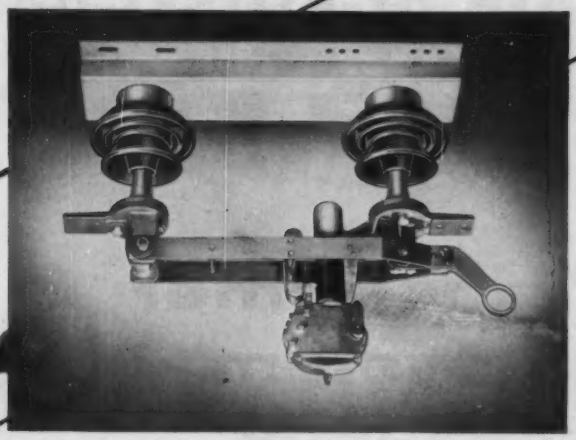
On 12 kv *radial* circuits, increased loads have made switching at sectionalizing points virtually impossible with conventional disconnects. On *loop* circuits (right) it's difficult enough where the duty involves only switching in parallel. And if the tie switches are open, hazard-free circuit interruption can be an impossibility.

Here, S&C Load Interrupters will give you safe, positive, circuit interruption on full line voltage and full load current—an advantage under emergency conditions, and a convenience under normal circumstances.



Specialists in High-Voltage Circuit Interruption since 1910

S&C



The S&C Load Interrupter, Alduti type; outdoor, single pole, (stick-operated); 14.4 kv, 600 amp. Three-pole, group-operated load interrupters are also available.

Load Interrupter Performance Comparison

PERFORMANCE	S&C Load Interrupters		Conventional Disconnects	
	Stick-Operated	Group-Operated	Stick-Operated	Group-Operated
Interrupt current from parallel sources safely?	YES	YES	DOUBTFUL	DOUBTFUL
Safe to equipment or personnel if inadvertently opened on full voltage (in case loop is open)?	YES	YES	NO	DOUBTFUL
Dump load without opening feeder breaker, or without preliminary unloading?	YES	YES	NO	DOUBTFUL
Multi-pole device controllable from ground (may be required by system practice or other circuits on same pole)?	NO	YES	NO	YES
Interrupt line charging current safely?	YES	YES	NO	DOUBTFUL
Cost?	LOW	HIGHEST	LOWEST	HIGH

The S&C Load Interrupter can switch the circuit without unloading preliminaries and without opening the breakers. The use of S&C Load Interrupters cannot lead to dangerous phase-to-phase or phase-to-ground faults, because there is NO EXTERNAL ARC. Also there is no danger to men or equipment in case of inadvertent operation. The S&C Load Interrupter breaks all load and charging currents instantly and decisively. Besides, you can mount it in any desired position —vertical, upright, or inverted. Write today for Catalog Section 760 on S&C Load Interrupters.

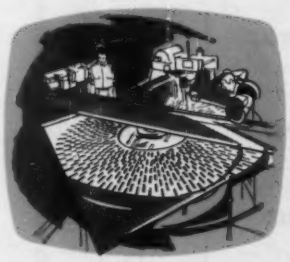
LOAD INTERRUPTERS

S&C ELECTRIC COMPANY

An example of Allis-Chalmers

550-BIL Transformer for 161-kv system raises efficiency, cuts weight, size

Here's dramatic proof of progress!



Close manufacturing control is illustrated by this A-C designed machine used to place precisely the tens of thousands of spacers for directing oil flow.

Valuable experience was gained from building and using this 600-kv transformer for test and research.

A few years ago a 46,667-kva transformer with a combination of reduced insulation, corona-free design, high short-circuit strength and quick-break tap changer would have been the sensation of the industry.

Today, as a result of design research and experience, production of transformers like this is a reality.

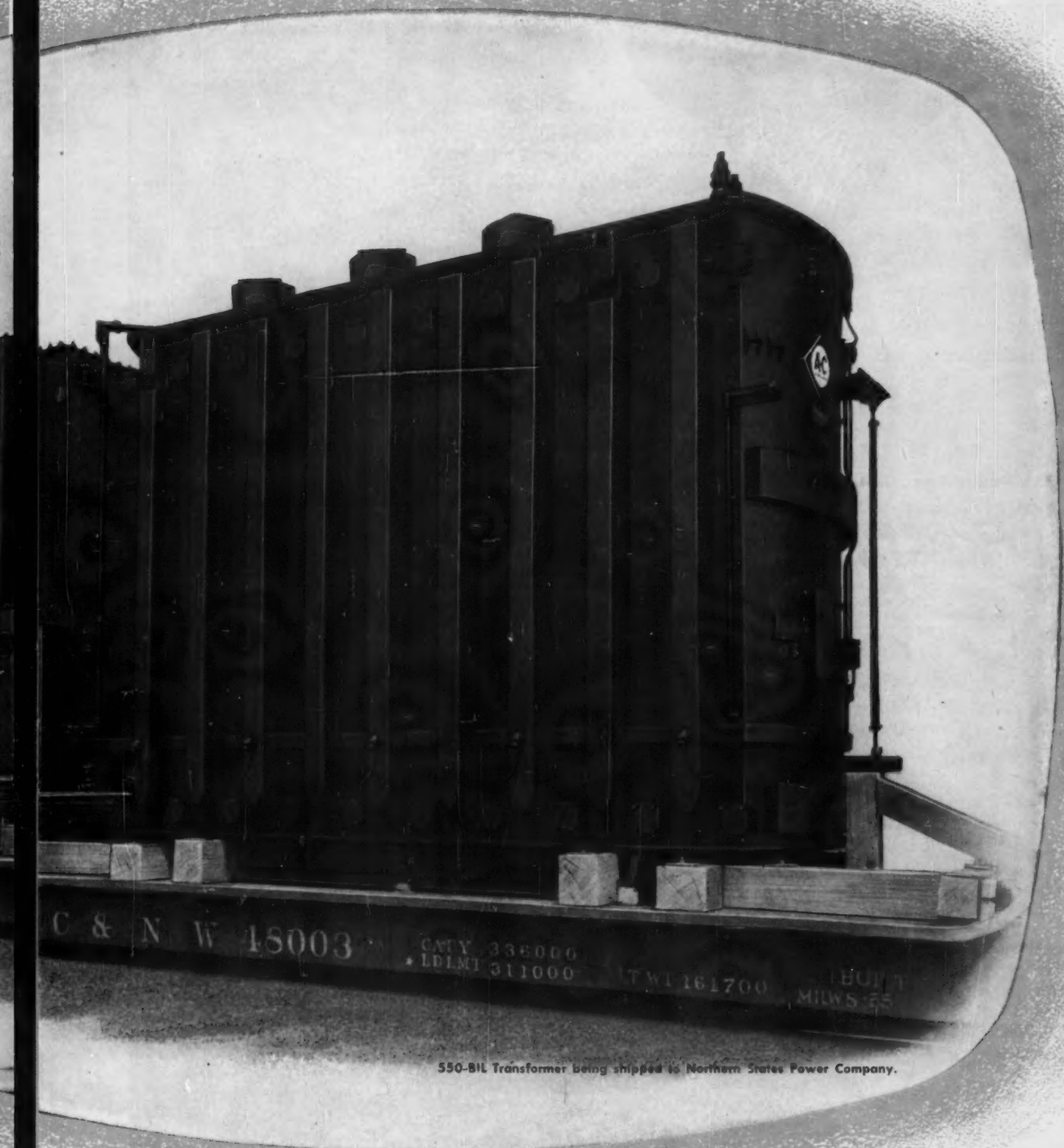
Insulation for this 161-kv transformer would normally be used for 115 and 138-kv units. This reduction of two steps is the result of coordination of modern "corona-free" insulation and improved system overvoltage protection. It makes possible substantial savings in weight, size and cost while increasing efficiency without sacrificing reliability.

Concentrated research on reduced insulation was begun by Allis-Chalmers in the 1930's. After the interruption of World War II, new test methods and manufacturing controls were developed to take advantage of this advanced engineering knowledge. As a result, today's A-C transformer is constructed on a triangle of quality: experience . . . design . . . and close manufacturing control.

For details on the engineering of this interesting design, call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

leadership in transformers



550-BIL Transformer being shipped to Northern States Power Company.

Pioneer Service & Engineering Co.

A-C ALLIS-CHALMERS

A-5510

PREFORMED ARMOR-GRIP SUSPENSION UNITS provide a

Pretty Soft Life for a Conductor

. . . cradled in durable neoprene

No vibration fatigue here. The Preformed Armor-Grip Suspension Unit (AGSU) eliminates failure by eliminating stress concentration.

The conductor is cushioned in a split neoprene core, held securely by Preformed rods that never lose their tight grip, and supported in an aluminum housing. Conductor is protected and longitudinal stresses are distributed through the entire length of the rods—not at one point.

Like other Preformed line accessories, the AGSU obsoletes bolted hardware. It's easier to apply (no tools needed), costs less, does a better job. You get mechanical strength and electrical protection, and—because of the smooth contour and large diameter of the rod ends—corona emission and radio influence are minimized.

Want to know more about the Preformed Armor-Grip Suspension Unit—or see the application demonstrated? Write PREFORMED LINE PRODUCTS COMPANY, 5349 St. Clair Avenue, Cleveland 3, Ohio. Cable Address: Preformed-Cleveland . . . in 10 years the leading manufacturer of armor rods, dead ends, Guy-Grip dead-ends and other line accessories.

PLP

You can look up to Preformed

Made in accordance with or for use under one or more of the following U. S. Patents: 2,722,393; 2,275,019; 2,587,521; 2,609,653; 2,691,865; other patents pending.

NEWS-SCOPE

SHIPPINGPORT ▶ **Electric power was generated on a test basis for the first time on Wednesday, Dec. 18,** as EW went to press.

The event occurred at 12:39 AM as Duquesne Light operators synchronized the generator with the company's system and began to increase the electricity produced by the station. The plant had reached 12,100 kw by 7 AM.

A carefully planned testing program during the next several weeks is designed to determine the plant's operating characteristics and establish its dependability. Shippingport is expected to have an initial electric capacity of 60,000 kw.

Electric power production came 16 days after the self-sustained nuclear reaction was started. At that time, control rods in the nuclear core were raised enough to permit initial chain reaction.

AEC Chief Lewis Strauss, in Paris attending the NATO conference, said: "Inherent safety will make the design of this first full-scale atomic power plant useful in many parts of the world." **Philip** Fleger, Duquesne board chairman, said the event "marks another major advance toward abundance of low cost atomic power. We must bend every effort to hasten as a lot of hard work remains. . . ."

LATE NEWS ▶ **Electric utilities will spearhead a 10-point "panacea for ending the TVA squabble"** during the next session of Congress. The new program, announced by Pennsylvania P&L's Charles E. Oakes and prepared by Electric Companies Public Information Program, would require TVA to pay taxes and interest, to remain within its present service area, and to become subject to FPC regulation. For the complete story, be sure to see next week's Electrical World.

Because of higher defense expenditures, there won't be money in the 1959 budget to start 72,000-kw Flaming Gorge dam. This is context of wire from Sen Joseph O'Mahoney (of Interior and Insular Affairs Committee) to governors within Upper Colorado project area. Continuing funds will be provided for 800-Mw Glen Canyon dam.

AG&E system will spend record $190 million for construction in 1958. previous record was $166 million in 1957. Pres Philip Sporn predicts AGE system's electric energy sales will be 21½ billion kwhr in 1957, reportedly a one-year record for the industry.

Congratulations . . . Westinghouse names Mark W. Cresap, Jr, president as Gwilym A. Price becomes full-time chairman. E. V. Huggins becomes chairman of the board's executive committee, J. K. Hodnette becomes executive vice president, and G. G. Main becomes vice president—finance. E. E. Dalton becomes controller; C. P. Myers, corporate secretary; and R. B. Read, assistant treasurer.

ELECTRICAL WEEK

A TWO-MINUTE

WASHINGTON ▶ **Utility expenditures for new plant and equipment will drop** in the first quarter of 1958, maintaining the downtrend that began the middle of this year, finds a SEC-Commerce survey (p 34).

ATOMIC PROGRESS ▶ **Pennsylvania P&L and Westinghouse propose building** a full-scale atom plant using aqueous homogeneous reactor, producing 70 to 150 Mw power, at a $57-million cost . . . Carolinas Virginia Nuclear Power Associates details a four-stage nuclear-power developmental program (p 35).

MEETING ▶ **Should you buy coal on a Btu basis?** "Not on a Btu basis alone," argues H. G. Lammers, Appalachian Coal Inc., who believes quality coal offers more than high heat content (p 39).

GENERATION ▶ **A once-through boiler has been chosen to serve in a subcritical** steam operation at Frank M. Tait station, which is undergoing modernization and expansion. The boiler was picked because it would yield valuable experience, and offered the possibility of lower capital costs. Author Howard Gismond, Dayton P&L's chief mechanical engineer, says the company decided to modernize the Tait station, rather than build a new plant elsewhere, partly because of its nearness to the load center. In addition, some less-efficient equipment will be retired (p 52).

Dry-cleaning control-air filters to remove oil, water, and dust may extend filter life, and save $1,140 a year for Ohio Valley Electric Corp at its Kyger Creek station (p 59).

DISTRIBUTION ▶ **To save time and muscles,** Dallas P&L uses a gasoline-powered hoist to raise transformers up to 75 kva to the tops of poles. The portable hoist is particularly useful where power equipment on trucks can't be used—say in someone's back yard (p 59).

TRANSFORMERS ▶ **A survey of 84 power systems for practices** of power transformer operation revealed: Most utilities do not adhere closely to ASA loading guides for normal and emergency loading; most are not yet ready to accept a two-step reduction of BIL; most accept standard rather than non-standard transformer impedance at generating station and substations; one system out of four has transformers without self-cooled rating installed at unattended substations; use of load-tap-changing equipment will increase slowly; many use mobile stations, and operate single-phase banks without spares; most do not provide spare transformers at important generation stations; most scrap obsolete units with respect to age, physical condition, and cost of reconditioning; the use of single-circuit integral-type unit substations is on the downslide; and, aside from lower price, the most-wanted transformer development is "lower noise level." Details of the study start on p 42.

PREVIEW OF THIS WEEK'S ELECTRICAL WORLD

SUBSTATIONS ▶ **Vepco has developed basic, unit-type structures for 132,** 110, and 66-kv substations to save engineering and drafting time, to speed steel ordering, and to minimize expansion costs **(p 51).**

RELAYING ▶ **Pennsylvania P&L is using an audio tone carried over pilot wires** to relay its critical 23-mile, 220 kv Martins Creek-Siegfried line. Loss of the line might mean system instability, and high-speed relaying and reclosing is mandatory. Five relaying systems were studied: Ac pilot wire, distance, power-line carrier, microwave, and audio tone. Authors Oewel and Burleson of PP&L and Westinghouse, respectively, tell why the audio tone system was picked. They also discuss technical intricacies of the system, including the two times when tone transmission was lost **(p 47).**

SELLING ▶ **Con Ed has a captive audience** for its model "Rocking Chair Kitchen." Customers who come to the Westchester office to pay bills find themselves surrounded by gleaming appliances. Payment is taken over the top of the kitchen's washer-dryer unit **(p 64).**

FINANCE ▶ **Earnings of 76 electric and gas companies rose 11%** in the third quarter of 1957, a First National City Bank survey shows, but the increase in net income does not necessarily reflect new capital invested in the business **(p 85).**

PEOPLE ▶ **Utilities must "keep a step ahead" of technology** to maintain leadership, says Newell A. Clark, new president of Merrimack-Essex Electric Co **(p 34).**

West Penn Electric Co makes H. F. Butler chairman, J. L. Rice president, and M. G. Miller vice president . . Mississippi Power & Light names Alex Rogers vice president and secretary . . Central Illinois Public Service Co's Hugh M. Parker becomes vice president in charge of finance on Jan. 1 **(p 95).**

MANUFACTURERS ▶ **Electrical Insulating Materials Assn organization** committee is to be continued as an informal but active group; meanwhile the working group will explore ways of cooperating with existing organizations for two-way flow of insulation data from makers to users . . . New pole-top scaffold developed to assist linemen **(p 89).**

NEW EQUIPMENT ▶ **Capacitor housing assembly for indoor and outdoor use** may be installed near low-lower-factor loads. Standard 3-phase assembly includes single-phase capacitor units, buswork, fuse clips, and one current-limiting fuse per capacitor . . . Low resistance ohmmeter measures resistance down to 10 microhms . . . Portable, powered cable reels are used to re-reel cable from one drum to another, and to pull cable through conduit **(p 75).**

ENGINEERING TRENDS

Air bubbles aid engineers in cutting construction costs. By using empty tin cans an air cushion can be set up between the explosion air and the adjacent surroundings. The air cushion can absorb the explosion force in a very thin shallow absorption area. The Ontario Hydro-Electric Commission of Canada credits the system with saving them about one million dollars when it was necessary to do some blasting adjacent to two generating stations. The alternative to the bubble system was to shut down the stations and import power from the States.

The solion, a new electronic device, extends miniaturization of control equipment. Some consider it a replacement for transistors particularly at frequencies below 100 cps. It utilizes ions in solution to transport electrical charges. When an alternating pressure is applied to the device, iodine ions in solution are forced into contact with platinum electrodes. The ensuing electrochemical reaction releases electrons and causes a correspondingly large increase in the flow of electrical current in the external circuit.

New rubber-metal bonding process will be useful in protecting metals from corrosion. The process, perfected by Bell Telephone Laboratories, is based on synthetic material known as "partly hydrogenated polybutadiene." Excellent bonds have been made between polyethylene and brass or brass-plated metals. The resulting adhesion will resist a pull of about 1,000 psi.

Burning coal underground for electricity production will be attempted in England with a 5-Mw pilot plant. Air blown through a burning coal seam will be converted into a low-grade producer gas with a calorific value of 100 Btu per cu ft. This gas is combustible and will be burnt in a utility type boiler. A 60-Mw commercial scale gasification plant will be built if the pilot plant proves successful.

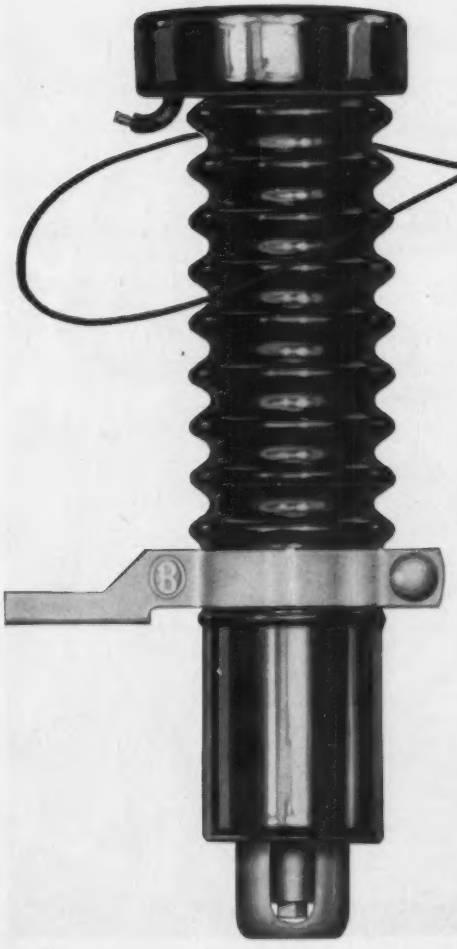
FROM EDITORS IN THE FIELD

Rough fish, a menace to power plant trash racks, can be killed by poison without harmful effects to game fish. A recent application of one part of Pro-Noxfish to 200 million parts of water by the Arkansas Fish & Game Commission killed rough fish in Arkansas Power & Light Co's Lake Hamilton. The mixture killed about 90% of the rough fish (shad & drum) present and 1% of the game fish.

Certificate of test showing accuracy data, glued to single-phase meters, saves about $7,000 annually as compared with former meter test records maintained by a Southeastern utility.

BEST BUY! in distribution arresters

Thorex Dynagap distribution arrester with line-to-ground rating of 12 kv, and equipped with automatic ground lead isolator. Similar ratings are available with external air gap, as well as other models for application by transformer builders. Essential Dynagap elements of these arresters are identical to those used in the highest voltage station class equipment. As a result, performance of the new Dynagap distribution arrester establishes entirely new standards in this class of service.



New Thorex Dynagap puts station quality construction on your poletops . . .

Station class arrester quality on your pole-tops!

Virtually, this is what you get in the new Thorex Dynagap distribution lightning arrester. Essential Dynagap elements are interchangeable between highest transmission and lowest distribution voltages. This brings to the distribution field a whole new order of performance, including unheard-of surge durability as well as low IR discharge voltage.

Thorex Dynagap arresters are not limited by system fault current magnitude or distance from the power source. They may be right at your largest station or on the end of your longest "stringy" circuit. In either case, their protective ability is exceptional.

Size reduction, ranging up to half that customary in the higher voltages, improves construction convenience and reduces the cluttered appearance of transformers. These smaller sizes retain generous leakage distance.

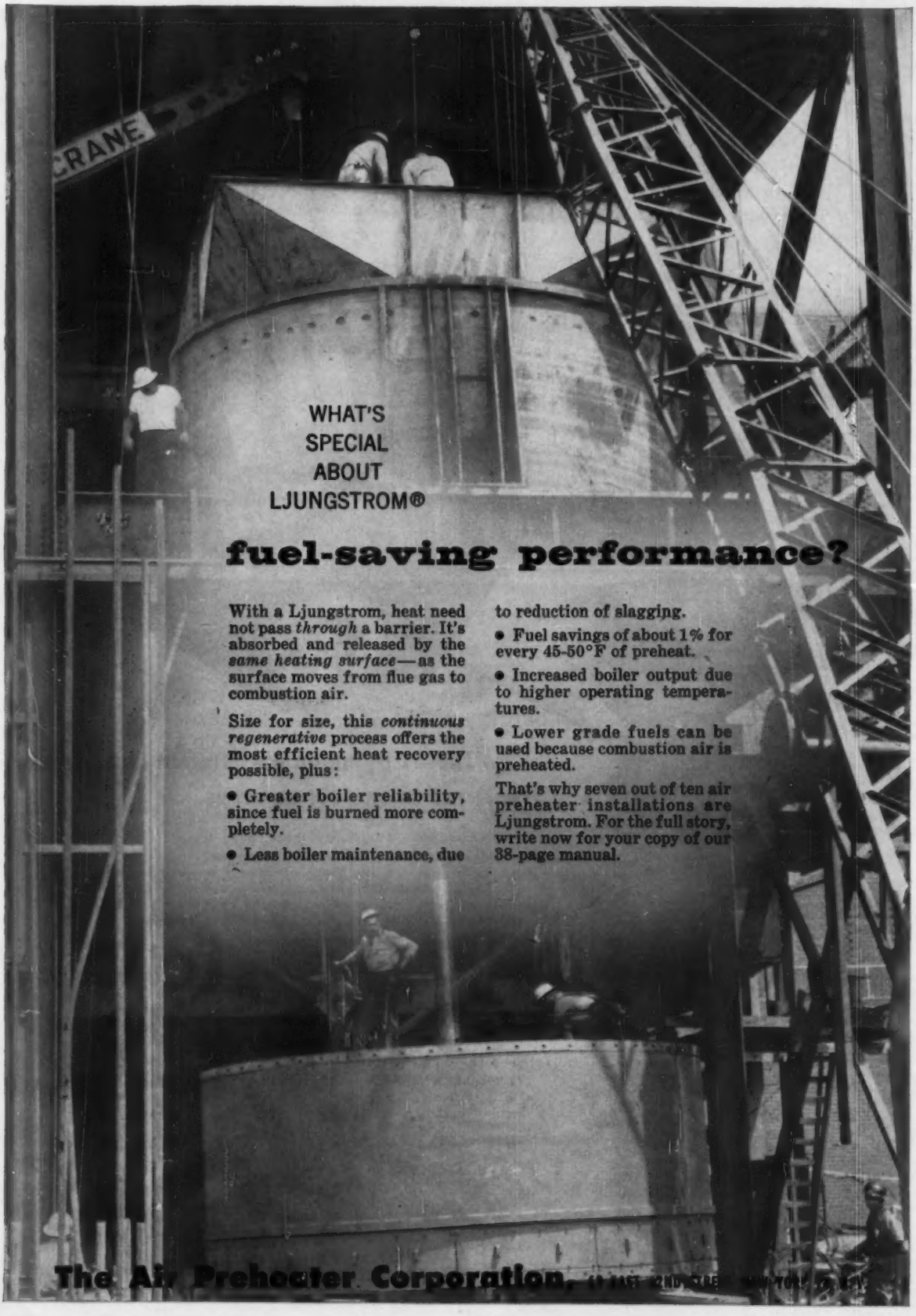
These many new advantages are yours without a cost premium.

For the most arrester you ever bought — for durable protection comparable to station quality — start installing the Thorex Dynagap on your distribution circuits.

OHIO BRASS COMPANY • MANSFIELD, OHIO

Ohio Brass

4782-H



WHAT'S
SPECIAL
ABOUT
LJUNGSTROM®

fuel-saving performance?

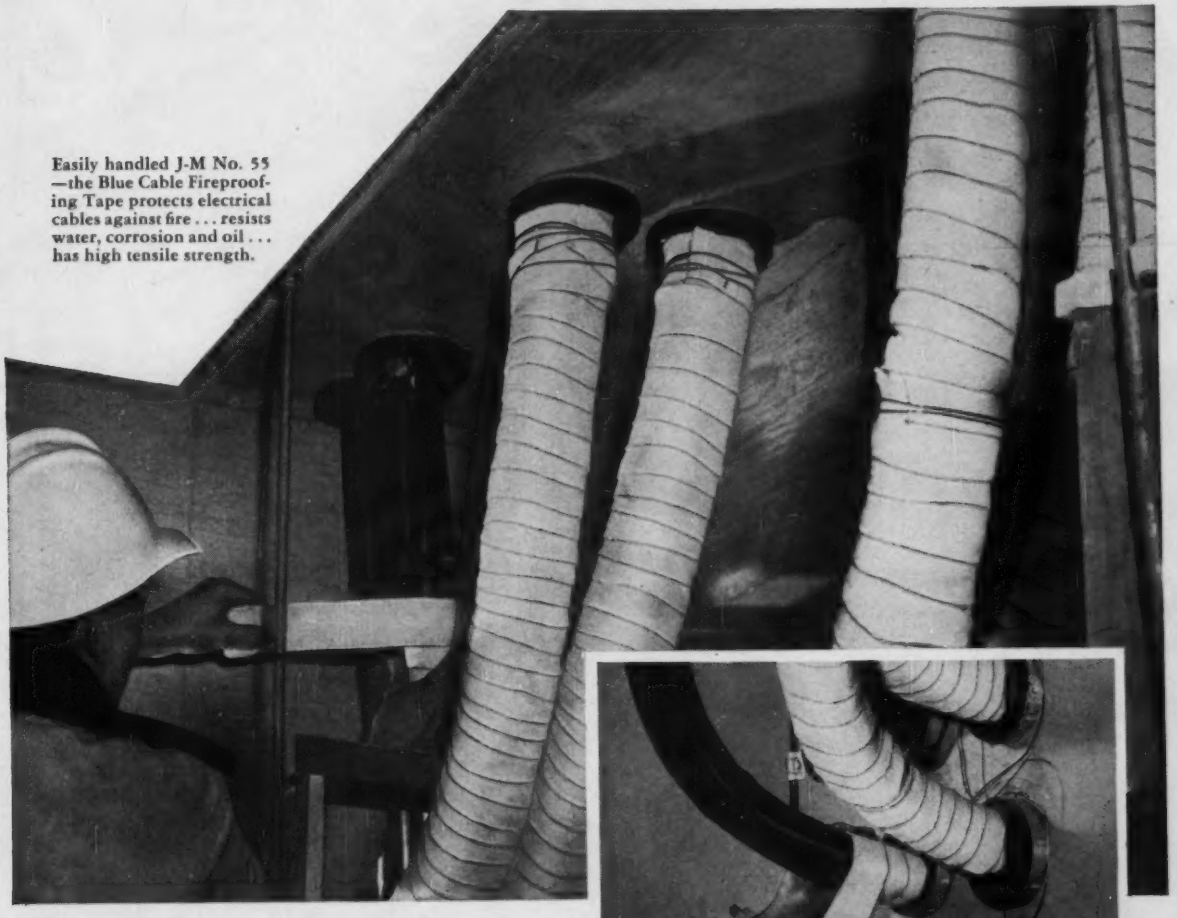
With a Ljungstrom, heat need not pass *through* a barrier. It's absorbed and released by the *same heating surface*—as the surface moves from flue gas to combustion air.

Size for size, this *continuous regenerative* process offers the most efficient heat recovery possible, plus:

- Greater boiler reliability, since fuel is burned more completely.
- Less boiler maintenance, due to reduction of slagging.
- Fuel savings of about 1% for every 45-50°F of preheat.
- Increased boiler output due to higher operating temperatures.
- Lower grade fuels can be used because combustion air is preheated.

That's why seven out of ten air preheater installations are Ljungstrom. For the full story, write now for your copy of our 38-page manual.

The Air Preheater Corporation, 60 EAST 42ND STREET, NEW YORK 17, N.Y.



Easily handled J-M No. 55 —the Blue Cable Fireproofing Tape protects electrical cables against fire . . . resists water, corrosion and oil . . . has high tensile strength.

Photos courtesy of Lone Star Cement Co., Dallas, Texas

ELECTRICAL CABLES . . .

Fireproofed quickly . . . to last!

with J-M No. 55 Asbestos Cable Fireproofing Tape

Here is the effective, time-saving fireproofing for electrical cables . . . designed for lasting protection.

Made of asbestos, Johns-Manville No. 55 Cable Fireproofing Tape offers many outstanding advantages. It will not support combustion; repels water, resists flame, fungus, mold, corrosion and oil. Explosive or toxic gases will not develop under arc. High tensile strength is maintained even after burnout.

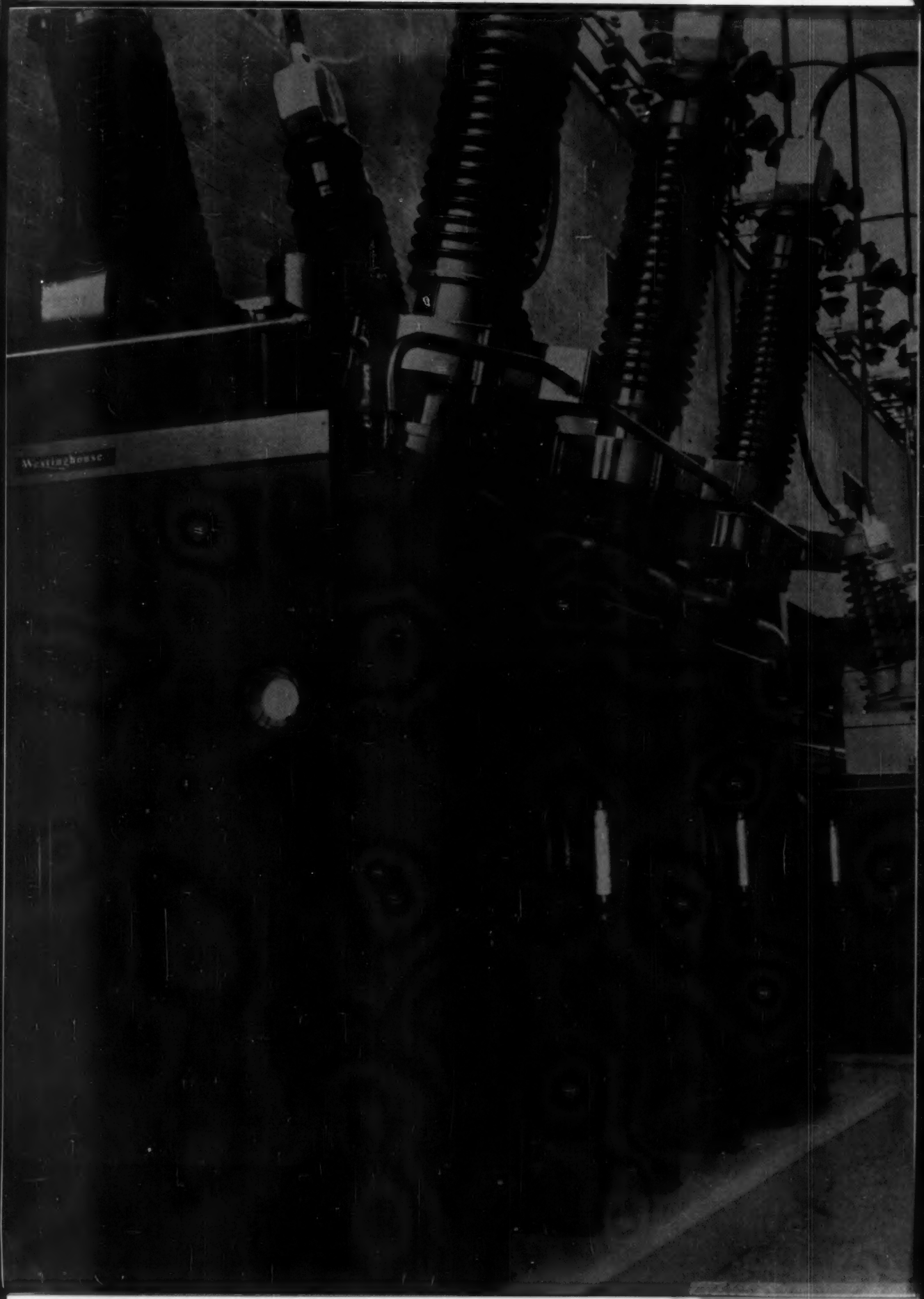
In addition, No. 55—the Blue Cable Fireproofing Tape is impregnated with a silicone material that provides low water absorption and high moisture repellence. Thus, damage from ground water, flooding, fog or humidity is minimized. Selvedged edges prevent threads from pulling out and weakening the tape. There are no ragged, unimpregnated edges through which ground water can penetrate.

J-M No. 55 Cable Fireproofing Tape is simple to apply, even in confined spaces. It won't droop, sag, or unravel . . . assures a tight, lasting wrap. Furnished in widths from 1" to 3" in 25- or 100-foot rolls, it is easy to handle and stock.

For complete information on J-M No. 55 Cable Fireproofing Tape, write to Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

Johns-Manville ASBESTOS TEXTILES

JOHNS-MANVILLE JM PRODUCTS


Westinghouse

Helping the industry meet its growing loads

New 138-kv air breaker brings high-voltage economies to congested load areas

Westinghouse developed this new compressed-air breaker to meet the need of utilities for higher voltages in crowded industrial and downtown sections. Line losses with voltages generally available on utility systems have been staggering. Although many utilities have planned for higher voltages to combat these losses, they have until now been limited by available air circuit breaker ratings to substations of 69-kv with 5-million-kva fault capacity.

Now, through the forward-looking research facilities at the High Power Laboratory, Westinghouse has made available the first steel dead-tank 138-kv compressed-air breaker with an interrupting capacity of 10-million-kva. The inherent safety of this air breaker permits location of substations right in the heart of the city. The first installation, at Consolidated Edison of New York, is used to protect their urban system.

These Westinghouse breakers operate at a comparatively low noise level, so important in busy downtown areas, through use of a unique exhaust-chamber design permitting release of compressed air through the bushing. Every day, Westinghouse research and development works to increase utility operating efficiencies by making available products such as this new 10-million-kva compressed-air circuit breaker.

J-97213

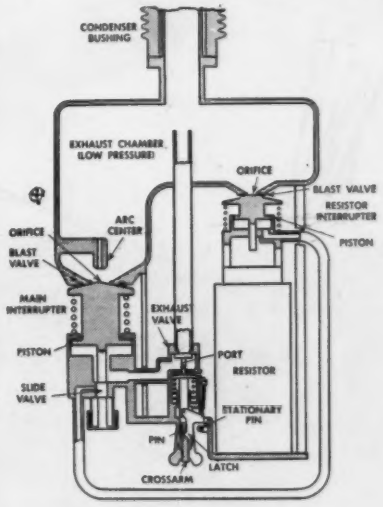
YOU CAN BE SURE...IF IT'S

Westinghouse

New compressed-air design

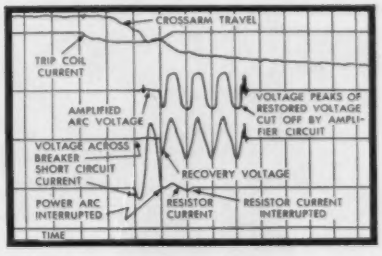
The new Westinghouse breaker incorporates many of the best features of both oil and air breakers. For instance, provisions are made for the use of bushing-type current transformers and potential devices. Two orifice interrupters, of the time proven 69-kv type, are used in series for 138-kv operations. Circuit interrupters are suspended from the ends of the condenser bushings. Mechanically interlocked drive operates all three pole units simultaneously, minimizing pneumatic variation.

Initial downward movement of crossarm isolator actuates pneumatic sequence: air interrupts arc as main contacts open, current is transferred to resistor, resistor contacts open . . . air interrupts arc . . . circuit interruption is complete, moving contact bar breaks away from interrupter . . . deactivates air circuit. Orifice is reset for subsequent operations.



3-cycle interrupting

Standard ASA tests were made at 250 and 200 psi in the Westinghouse High Power Laboratory, demonstrating 3-cycle interruption with closing and reclosing timing within 20 cycles on a 60-cycle basis. Here's true protection for the modern high-voltage urban system . . . with high continuity of service.



Proved capacity

The oscillogram above illustrates the operation of a **single** interrupter assembly during the interruption of 44,000 amperes. The breaker will withstand system voltages at atmospheric pressure.

BUYER'S GUIDE

FOR STATION INSULATORS

Source of most reliable information is right in your own records

Is there such a thing as a "Buyer's Guide" for station insulators?

There is — and *you* wrote it!

Most power companies have records covering construction of each substation. They show the insulation used and replacements, if any, since that time. Nothing we can say will change these records or even color them.

Investigate your own history of O-B station insulator performance. Remember, differences in price are negligible. Therefore, it's only the difference in service that shows where you get the best mileage on your invested dollar.

Many insulators come to you, today, as components of manufactured products; unit subs, switches, etc. If you want to repeat your past experience, specify O-B by name when buying such equipment.

. . . and also build with O-B for your new station construction. Records in your own file will justify this decision.

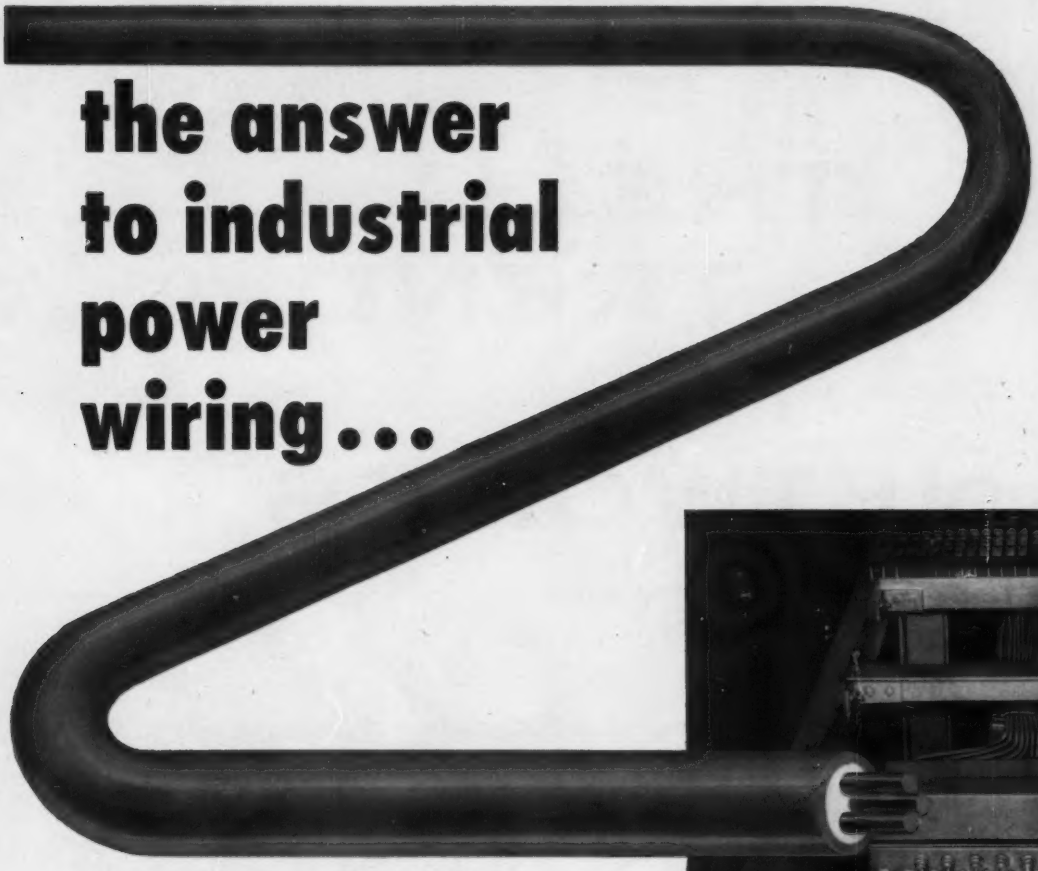
OHIO BRASS COMPANY • MANSFIELD, OHIO
CANADIAN OHIO BRASS CO. LTD., NIAGARA FALLS, ONT.

Ohio Brass

4772-H

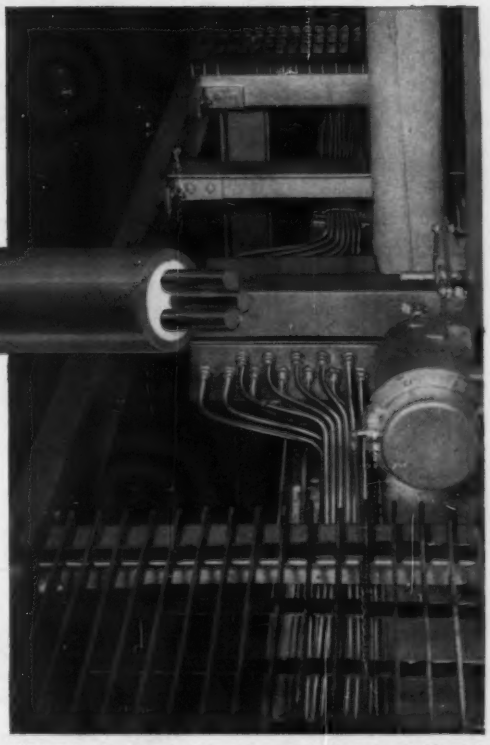
SAFETY m.i. CABLE

the answer to industrial power wiring...



- SPACE SAVING
- Time saving
- Permanent
- INSTALLED EASILY
- Fast power wiring to cut down-time

More and more General Cable's Safety MI 600 Volt Wiring System is being used because it can take the abuse of industrial application, giving trouble-free operation and unexcelled performance under the most severe conditions. Particularly adaptable in hot and wet locations. Available in 1, 2, 3, 4 and 7 conductor for power and control circuits.



MI terminating in main Japan Oven control center switchboard at Painsett Lumber and Manufacturing Company, Anderson, S.C.

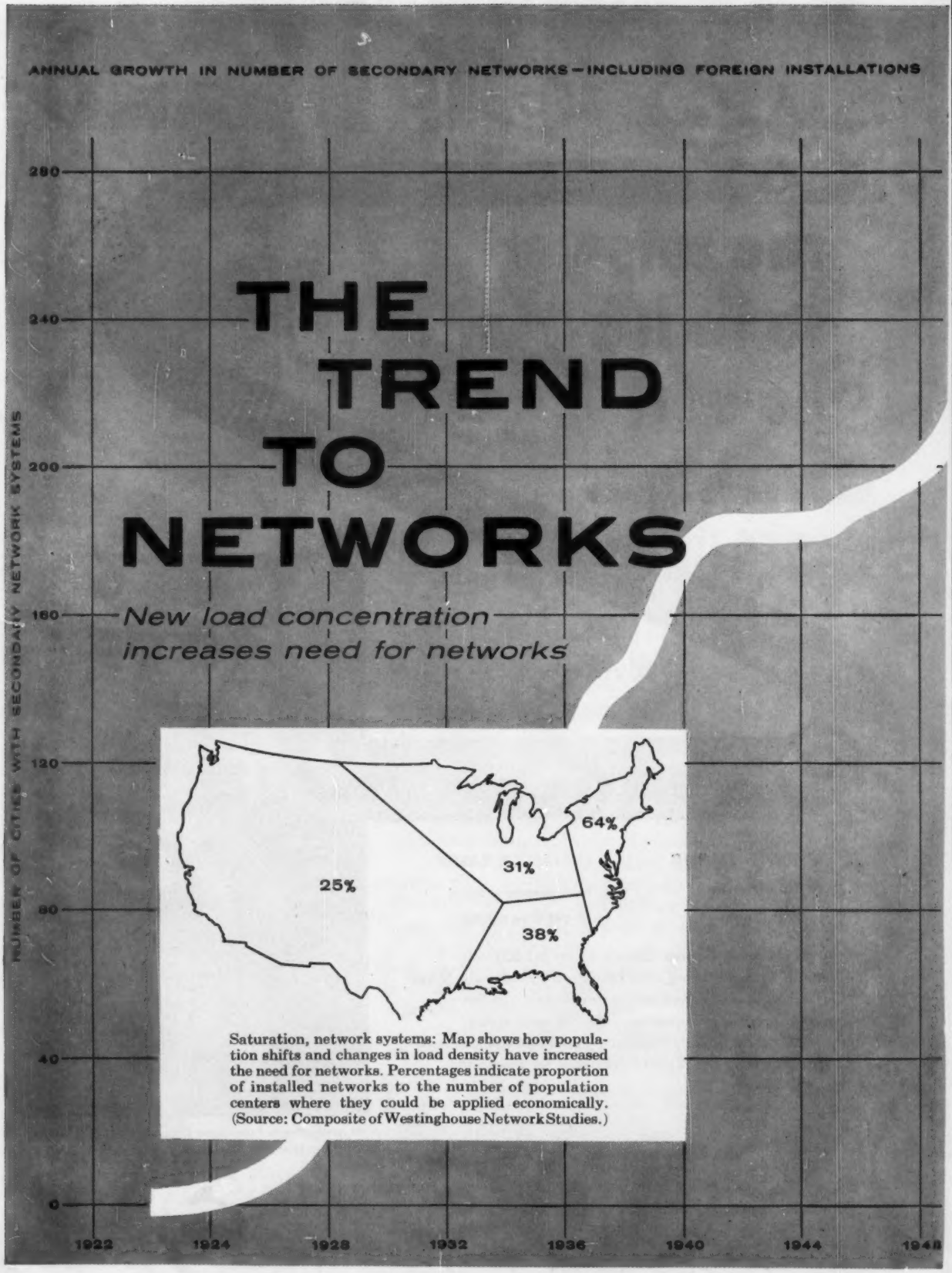
Ask for a Demonstration To-Day!

GENERAL CABLE CORPORATION, 420 Lexington Avenue, New York 17, N. Y.
Offices and Distributing Centers Coast-to-Coast

for quality and service...specify **GENERAL CABLE**

THE TREND TO NETWORKS

New load concentration increases need for networks



Saturation, network systems: Map shows how population shifts and changes in load density have increased the need for networks. Percentages indicate proportion of installed networks to the number of population centers where they could be applied economically. (Source: Composite of Westinghouse Network Studies.)

TWO FACTS STAND OUT:

1. Over 280 automatic a-c network systems have been put into operation since the first installation in 1922.
2. Westinghouse systems experts estimate that 58.1% of U. S. cities that could use networks economically do not have them.

Fact one, particularly in the trend of the postwar years, indicates that network systems are achieving increasingly rapid acceptance . . . thirty-four years of unchallenged superiority when accommodation for load growth, flexibility, and dependability are of paramount importance.

Fact two might indicate that many more cities should have networks under serious consideration right now. Do you have an area you serve where the a-c secondary network could be the answer to your projected distribution problems?

Westinghouse engineers will be glad to cooperate with you and your consultants in network studies. Westinghouse equipment can simplify your conversion and expansion problems. J-97201

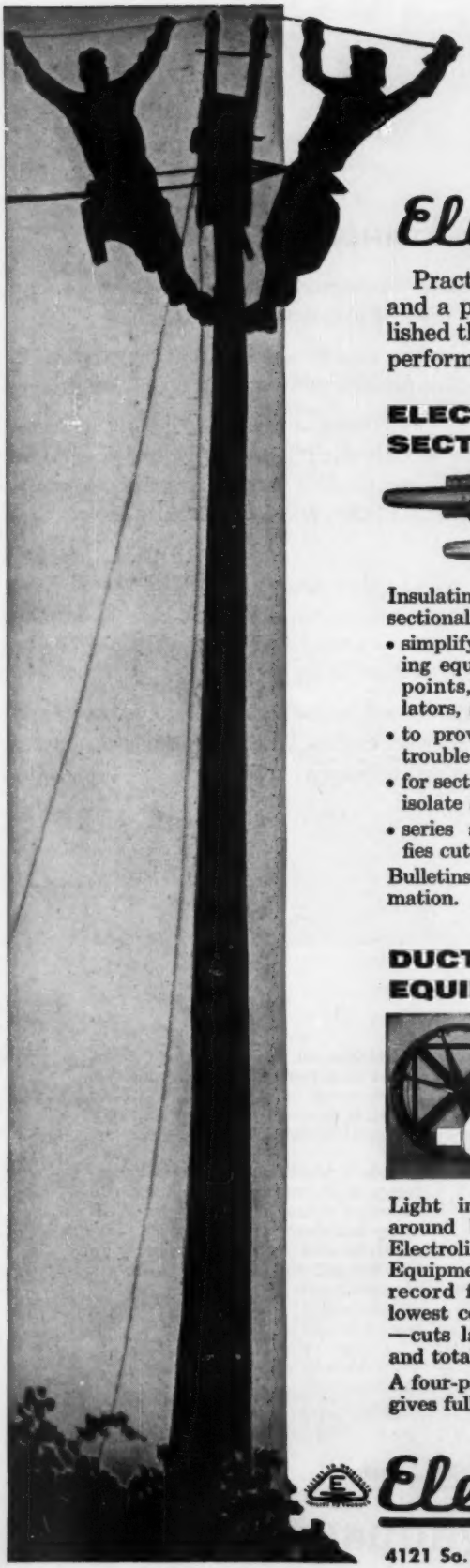
Westinghouse network transformer, liquid immersed, for vault installation below street or sidewalk level. Unit shown is Space-Miser design with new Yukon Coolers.

Standard Westinghouse network protector is shown, right. In addition to standard ratings, all classes, Westinghouse has developed units for heavy, medium and light load density in 120/208-volt and 265/460-volt service.

1952 1956

YOU CAN BE SURE...IF IT'S

Westinghouse

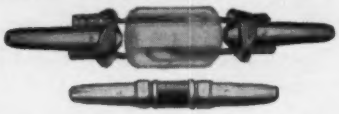


for the largest number of line applications, at the lowest possible cost . . .

Electroline Products

Practical experience designed these Electroline Products; and a practical habit of keeping close tab on costs has established them as first in the field—for top quality and economical performance.

ELECTROLINE SECTIONALIZERS

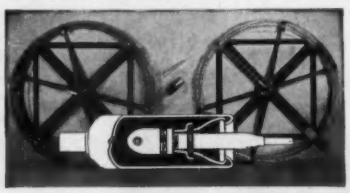


Insulating automatic line splice sectionalizers:

- simplify cutting-in of regulating equipment—disconnecting points, fuses, voltage regulators, series capacitors, etc.
- to provide points to test for trouble
- for sectionalizing networks—to isolate and test area in trouble
- series street lighting—simplifies cutting-in series lamps

Bulletins contain complete information.

DUCT-RODDING EQUIPMENT



Light in weight, feeds easily around bends, easy to handle. Electroline Steel Duct-Rodding Equipment has an extraordinary record for high efficiency at lowest cost. A big money-saver—cuts labor cost, original cost and total investment.

A four-page illustrated brochure gives full information.

AUTOMATIC LINE SPLICES

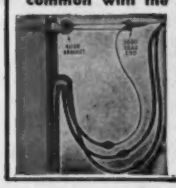
It is well said of these simple, rugged units—"They go on in no time; they hang on for all time." Easy to install—and their mechanical strength exceeds the rated breaking strength of the conductors. Ideal for restoring service.

AUTOMATIC DEAD-ENDS

In a typical "torture" test for strength, gripping and vibration damping features, 100,125,000 recorded vibrations did not develop any sign of failure of conductor in these rugged dependable Dead-Ends. Engineers call it equivalent to 50 years of ordinary service.

Electroline Service-Drop Automatic Dead End. The "3800" Series for holding pre-assembled service cable using a bare neutral conductor as the messenger.

The method of gripping the bare neutral employed by this ELECTROLINE Anchorage eliminates the danger of short circuiting the phase wires so common with the use of concentric cable clamps.



ELECTROLINE Service-Drop Anchor Bracket. The "4000" Series for securely supporting the cable at any angle.

Electroline Company

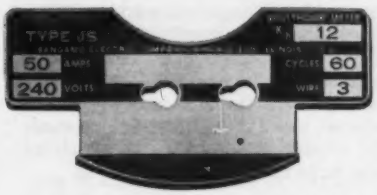
4121 So. LaSalle St., Chicago 9, Ill. In Canada: POWERLITE DEVICES, LTD., TORONTO

Sangamo Class 200 Meters

PROVED by 17 years of performance

With singlephase residential loads growing... with more and more 200 ampere service entrance equipment being installed every day, attention is being drawn to Class 200 Singlephase Meters. Yet the development of 200 ampere meters is nothing new. Sangamo singlephase meters with accurate 200 ampere capacity have been in use for 17 years!

THE NAMEPLATES TELL THE STORY...



IN 1940, Sangamo introduced the Type J Meter which pioneered modern singlephase meter design. The 50 amp J Meter gave excellent curves up to loads of 200 amperes. These meters have been on power company lines for 17 years.

IN 1955, Sangamo presented the J2 Meter—the first standard extended range meter in the industry. The 50 amp J2 Meter offered straight line accuracy up to 200 amperes with only 18 starting watts. These 200 ampere capacity meters are on your lines today.

NOW Sangamo offers its Class 200, 30 ampere J2S Meter at the same price as Class 100 Meters—with proven accuracy to 200 amperes, slow disk speed, high starting torque, low starting watts. Choose this *proven* Class 200 Meter to protect your investment in metering.

NOW...THEY'RE GUARANTEED FOR LIFE!

The electrical and mechanical stability of Sangamo Watthour Meters is so great that an unprecedented lifetime guarantee covering materials, workmanship and bearing systems—is offered on all new singlephase and polyphase meters using Sangamo's ball and jewel bearing system.

LIVE BETTER ELECTRICALLY

SANGAMO

ELECTRIC COMPANY *Springfield, Illinois*

JM57-10

HOW L-M INDUSTRIAL CAPACITORS GIVE A HIGH RETURN ON INVESTMENT

Raise low power-factor and reduce kilovars

...increase load capacity
...improve voltage conditions
...cut power bill

By N. K. DELANEY
Product Manager
Capacitors and Regulators
Line Material Industries

Low power-factor costs you money. With low power-factor you do not use your plant facilities efficiently. You also lose part of the electricity you pay for, because of excessive losses. Today, practically every plant has manufacturing processes with loads involving induction motors producing low power-factor. These are such loads as machine tools, pumps, fans, compressors and conveyers.

The use of capacitors improves the power-factor of the load. This reduces the KVA demand, and therefore cuts power costs. It automatically increases the load capacity of the plant circuits, and provides better voltage for equipment operation and lighting. In addition to providing better operation of the plant, capacitors can substantially reduce power costs another way: where there is a power-factor clause, based on a study of the clauses of a number of utilities, capacitors can save many times their cost.

Both Large and Small Plants Benefit

Almost every size of plant having a power-factor clause in its rate structure can justify capacitors. Studies show that it is generally advantageous to improve the power-factor beyond the maximum rate of return, because even though the rate of return becomes less, it is still economically attractive, and besides, additional system power capacity is released. A rough rule is to provide improvement to 90-95 percent power-factor.

The best way to determine the capacitor kilovars to use is to calculate the actual dollar savings for various power-factor values for your particular plant condition. See examples at left.

Location of Capacitors

The maximum benefit from capacitors is obtained when they are located

Two Examples of Savings With L-M Capacitors

These two examples are typical of the savings on power bills possible through the application of low-voltage industrial capacitors.

1. Small Industrial Plant

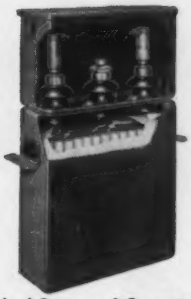
Here the rate structure included a monthly KVA demand charge, which averaged $172.28. Installation of $720 worth of capacitors cut the demand charge to $137.80, a monthly saving of $34.48. The savings will pay for the capacitors in 21 months. Here are the figures:

BEFORE Installing Capacitors		
KW	=	152
KVA	=	211
PF%	=	72
Monthly KVA demand charge	=	$172.28
AFTER Installing		
80 KVAR of 460 Volt Capacitors		
Approximate installed cost of capacitors	=	$720.00
KW	=	152
KVA	=	166
PF%	=	92
Monthly KVA demand charge	=	$137.80
Reduction in monthly KVA demand charge	=	$ 34.48
Number of months required to pay for capacitors out of savings in monthly KVA demand charge	=	21

2. Commercial Lighting User

Here the rate for a commercial user of a large amount of lighting equipment included a monthly KW demand charge with a power-factor penalty clause as follows: the monthly demand charge will increase 1% for each 1% the power-factor falls below 85%PF. Power-factor at the time was running around 76%. Installation of enough capacitors to bring the power-factor to 86% saved $24.41 per month, which is paying for the capacitors in 25 months. It figures out this way:

BEFORE Installing Capacitors		
KW	=	120
KVA	=	158
PF%	=	76
Monthly KW demand charge	=	$295.66
AFTER Installing		
30 KVAR of 230 Volt Capacitors		
Approximate installed cost of capacitors	=	$600.00
KW	=	120
KVA	=	140
PF%	=	86
Monthly KW demand charge	=	$271.25
Reduction in monthly KW demand charge	=	$ 24.41
Number of months required to pay for capacitors out of savings in monthly KW demand charge	=	25



Individual Dustproof Capacitor Unit

at the load. This is true for release of system capacity, voltage improvement, and power bill savings. On the other hand, other factors should be considered, such as load diversity, particularly when the plant contains a number of small loads. L-M engineers can help you with such problems.

Complete Engineering Service

As a large manufacturer of capacitors for utility applications, Line Material Industries offers complete engineering service on industrial capacitor installations.

Line Material development engineers will cooperate with you to determine the amount of capacity released by power-factor correction, voltage improvement, rate of return on capacitor investment, and the most advantageous capacitor location.

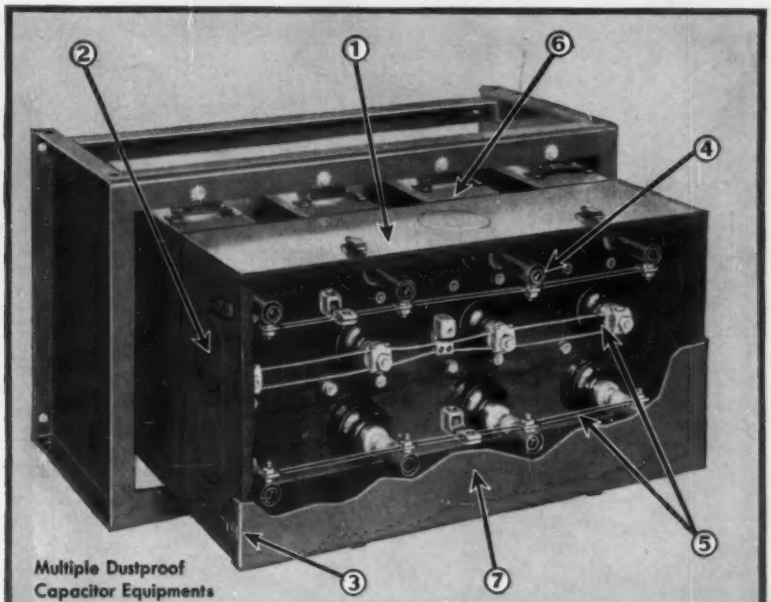
Complete Line of Industrial Capacitor Equipments

Line Material Industries offers a complete line of standard industrial capacitors, 230 to 575 volts, for installation at the motor, on the supply side of motor protective and switching devices, or at load centers.

Line Material capacitor equipments are dustproof. They can be floor, wall, or ceiling mounted. Multiple equipments are factory assembled into desired sizes, and completely wired. Installation is simple and fast. Equipments include boric acid indicating-type, terminal-mounted fuses.

Get Complete Information

Line Material capacitors may be the solution to your problem to increase load capacity, improve voltage conditions, or cut power billing. Call the nearest Line Material office for complete information and the location of the nearest distributor of Line Material equipment. Or write Line Material Industries, Milwaukee 1, Wisconsin.



Multiple Dustproof Capacitor Equipments

NEW L-M INDUSTRIAL CAPACITOR EQUIPMENTS

Have Outstanding Design Features

1. ***Enclosure***—one-piece all-steel construction.
2. ***Knockout***—3-inch on all four sides.
3. ***Cover***—one-piece, fastened by spring clips, easily removed.
4. ***Fuses***—boric acid indicating type, terminal mounted.
5. ***Internal Wiring***—factory assembled.
6. ***Unit***—strong solder-sealed bushings with low temperature Elemex liquid dielectric.
7. ***Finish***—primer followed by one coat of alkyd-resin paint.

Available in standard three-phase and single-phase ratings, 230, 460, and 575 volts.

Sold to industry through distributors. Call the nearest Line Material office for location of nearest distributor or write Line Material Industries, Milwaukee 1, Wisconsin.

LINE MATERIAL Industries

McGRAW-EDISON COMPANY

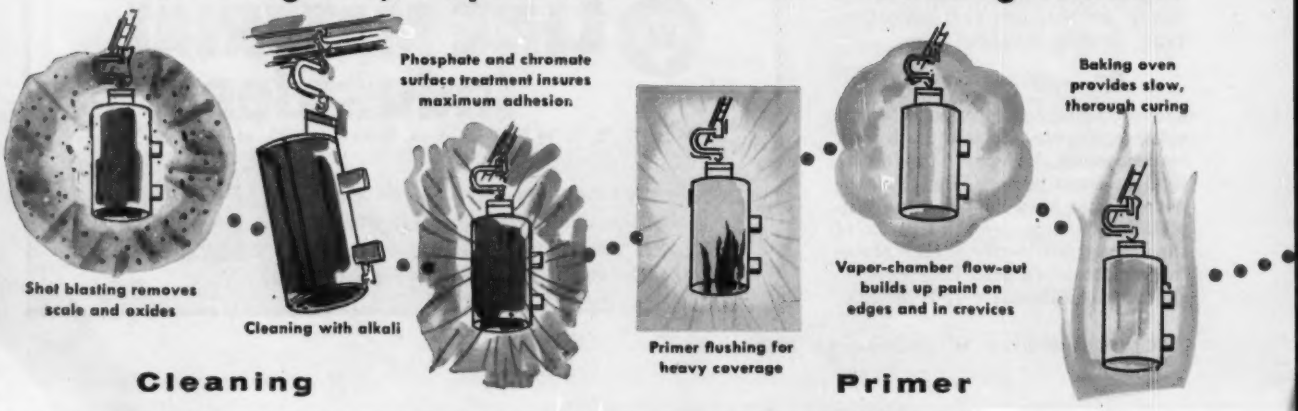
Transformers—Capacitors—Reclosers
Protective Equipment—Street Lighting
Power Switching Equipment—Regulators
Line Construction Materials—Fibre Conduit.

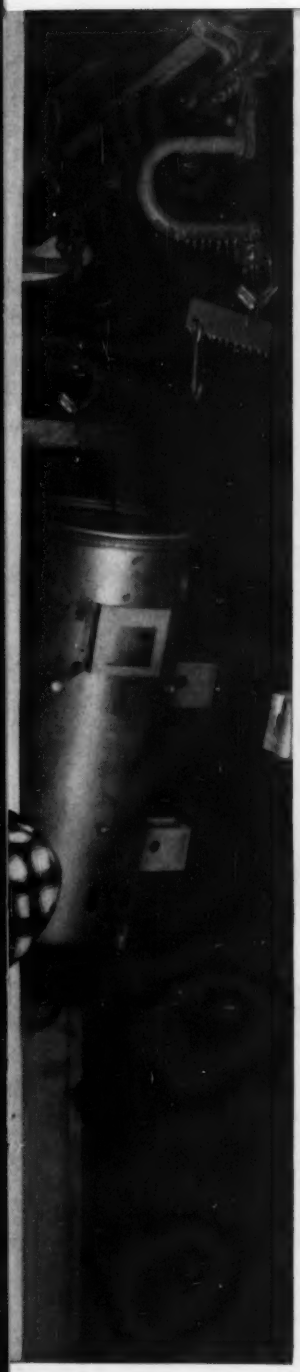
McGRAW EDISON

311

Tanks are on a continuous conveyor system. Photo shows heavy-viscosity primer as it is flushed on the transformer tank just prior to entering the vapor chamber.

Flow Diagram, Vapor-Chamber Flow Coating Process


Shot blasting removes scale and oxides
Cleaning with alkali
Phosphate and chromate surface treatment insures maximum adhesion
Primer flushing for heavy coverage
Vapor-chamber flow-out builds up paint on edges and in crevices
Baking oven provides slow, thorough curing
Cleaning
Primer



Another L-M First...

New Vapor-Chamber Flow Coating Protects Tank Edges, Crevices

By **MARTIN I. ZWELLING**
Assistant Manager of
Engineering, Transformers
Line Material Industries

Line Material has adopted a revolutionary new vapor-chamber flow coating process that radically improves tank-corrosion protection on L-M Round-Wound® transformers. The outstanding feature is that the vapor-chamber treatment improves paint film thickness and uniformity on edges, in crevices, and over welds—spots that characteristically are the first to rust.

The process includes seven-stage surface cleaning and preparation; flow coating with heavy, viscous primer and finish paints, each coat passing through the unique new vapor-chamber treatment. The secret of the process is that the vapor in the chamber carries a high concentration of paint volatiles. These keep the paint fluid, and the paint actually flows toward and completely covers critical edges, sharp corners, welds, and crevices.

Automatically Controlled

The heavy paint film is maintained as the tank passes through the baking oven. Humidity and temperature in the oven are closely controlled for proper curing. The entire process is completely mechanized. Automatic controls insure uniform paint coverage.

L-M's newly developed vapor-chamber flow coating process gives better tank protection, partly because it does everything that every previous paint process has done—and does it better—and chiefly because it gives extra protection to areas that are always the first to rust. Here are the principal features:

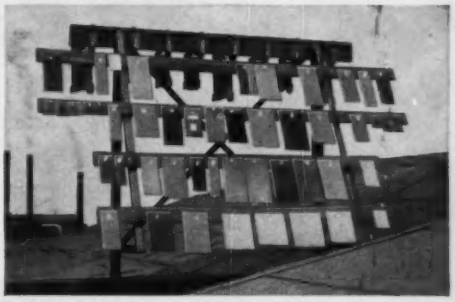
1. Thorough seven-stage surface treatment —shot-blasting, alkali washing, phosphating and chromic acid passivation, with intermediate rinses followed by dry-off to insure maximum adhesion.

2. Even coverage with highest-grade primer and weather-resistant finish paints.

3. Heavy build-up on edges, sharp corners, welds, and in crevices, resulting from flow-out during the vapor-chamber stages.

4. No human element—entire process is completely mechanized and automatically controlled.

All-Weather Paints



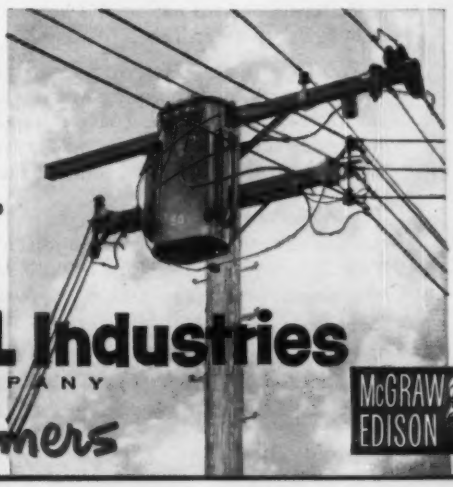
Typical outdoor test rack on which paint panels undergo two-year exposure tests in heavy industrial and seacoast areas. L-M has paints constantly under test—in the laboratory and outdoors.

In the laboratory, paints are subjected to standard tests and special exposures to salt spray and acid fumes which simulate and accelerate atmospheric conditions. From this continuous and extensive testing program L-M selects the paints that best survive these rigorous tests.

Get Complete Information On L-M Round-Wound Transformers

Tank protection is only one of the important features of L-M Round-Wound transformers. Other advantages are exceptional overload capacity, good regulation, low losses—and *Balanced Performance*. Ask the L-M Field Engineer for complete data, or write Line Material Industries, Transformer Division, Zanesville, Ohio.

Flow-coating with highest grade weather-resistant paint
Finish
Final baking insures long resistance to even the worst atmospheres
Vapor-Chamber Flow-out

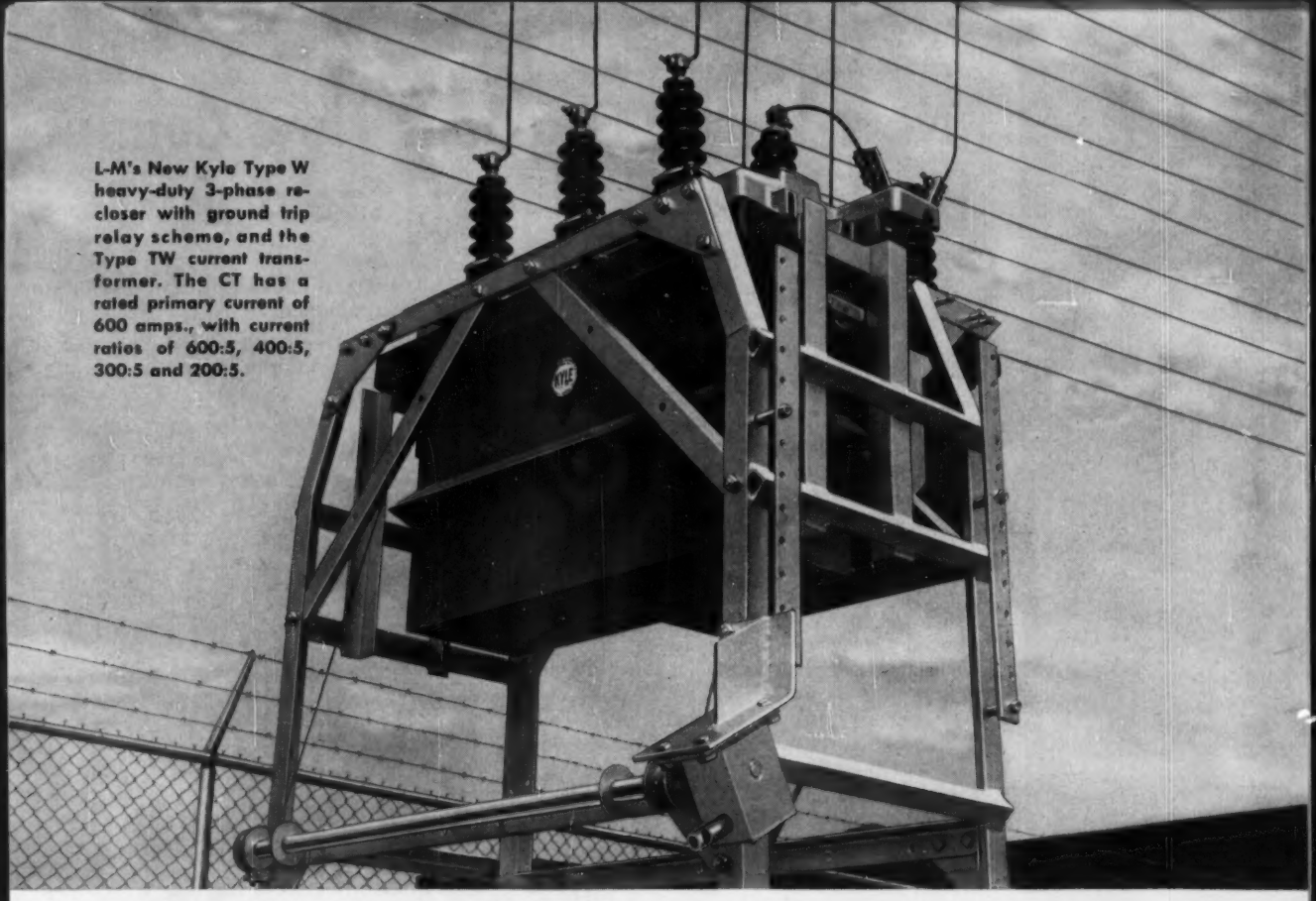


LINE MATERIAL Industries
McGRAW-EDISON COMPANY

304-R

Transformers

McGRAW EDISON



L-M's New Kyle Type W heavy-duty 3-phase recloser with ground trip relay scheme, and the Type TW current transformer. The CT has a rated primary current of 600 amps., with current ratios of 600:5, 400:5, 300:5 and 200:5.

At Half the Cost of OCB's...

Substation Type W Recloser Gives Greater Protection With Fast 2½-Cycle Clearing

By **FRANK McSTAY**, Product Manager, Kyle Products, Line Material Industries

Now, with L-M's new high-speed Type W Recloser, conductor burn-down of distribution feeder circuits is reduced to a minimum. This completely automatic and self-contained 3-phase unit clears so rapidly that up to 90% of the faults on typical distribution systems are prevented from becoming permanent. In fact, the Kyle Type W clears in less than half the time of distribution oil circuit breakers. This instantaneous opening results in better fuse coordination and helps to confine permanent faults to a small area.

The Type W also offers another advantage: by reducing the length of time during which fault current flows, the recloser permits using larger transformers without increasing the size of the wire on the system, or necessitating reactors to limit the available fault current.

200 MVA for Half the Cost

Besides safeguarding the distribution circuit, the 3-phase Type W offers large savings in both initial investment and maintenance. The unit is approximately half the price of an equivalent OCB for the same application.

Series over-current tripping is utilized with a selection of five time-current characteristics—fast, retarded, or extra retarded—in two degrees of slope—with 2, 3, or 4 operations to lockout, in many combinations of operations. In addition, L-M has a complete line of auxiliary equipment to provide almost any supplementary relaying scheme.

Ratings from 100 to 560 Amps.

L-M's Type W is available in normal load ratings from 100 to 560 amperes, with symmetrical RMS interrupting ratings up to 12,000 amperes at 4.8 kv and below, 10,000 amperes at 8.32 kv and below, and 8,000 amperes up to 14.4 kv. Current ratings can be changed in the field by simply replacing the series trip coils.

Get Complete Information

Ask the L-M Field Engineer for Bulletin CRIW giving more information on how L-M's new Type W recloser can be profitably applied to your system. Or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: Canadian Line Materials, Ltd., Toronto 13, Ontario.

McGRAW EDISON

LINE MATERIAL Industries Kyle® Reclosers

McGRAW-EDISON COMPANY

313

MerryChristmasMerryChristmasMerryChristmasMerryChristmas
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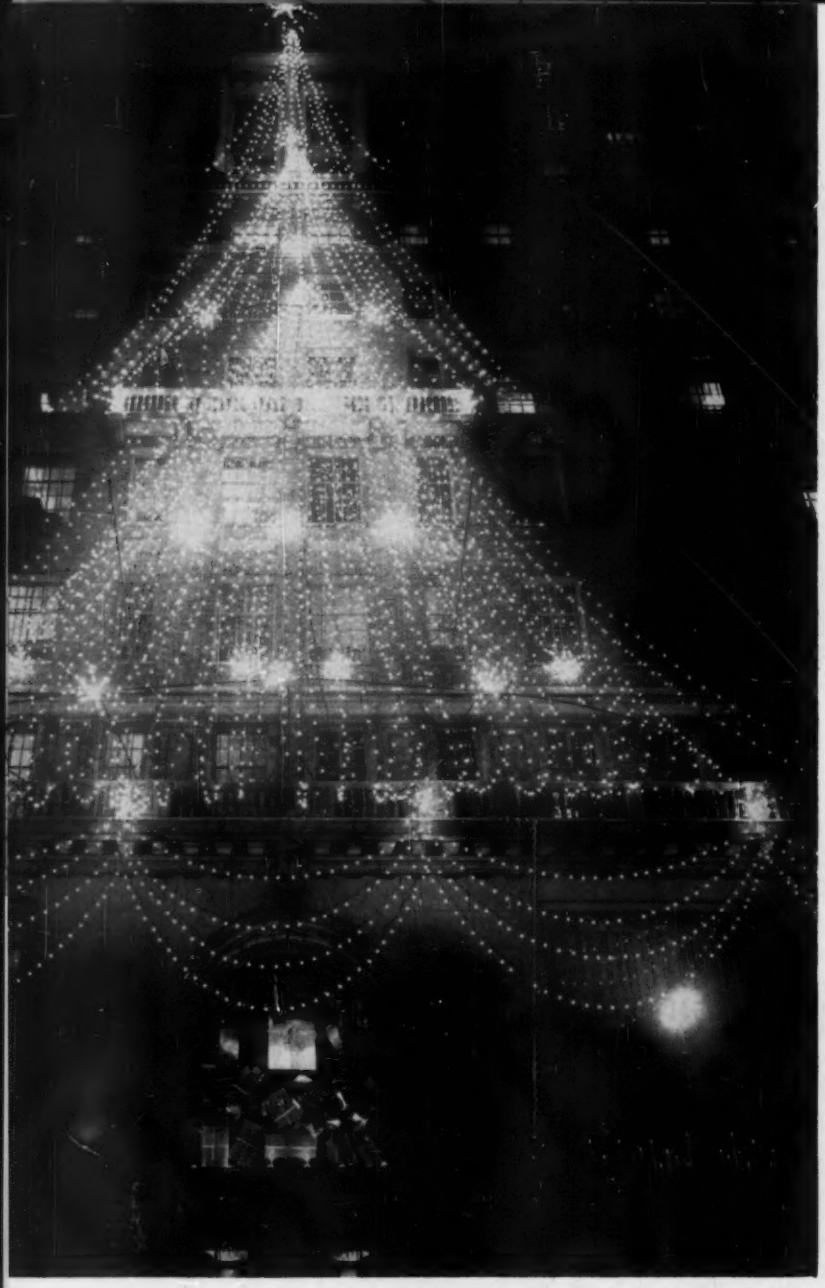
MerryChristmasMerryChristmasMerryChristmasMerryChristmas
Merry Christmas!
The mistletoe's above the door,
The mantle's hung with pine,
And every happy windowpane
Is bright with candleshine . . .
At last the children are in bed
And parents smile to see
The growing pile of dreams-come-true
Beneath the star-tipped tree.
Far off, the church bells bless the night
With wind-blown, silvery chime --
May Joy and Peace be with us all
Until next Christmas-time!
Maureen Murdoch

This is Tampa Electric Co's adaptation of the Christmas message furnished by Electric Companies Advertising Program and used by several companies



Christmas

Paris, France

Vienna, Austria

Brussels, Belgium

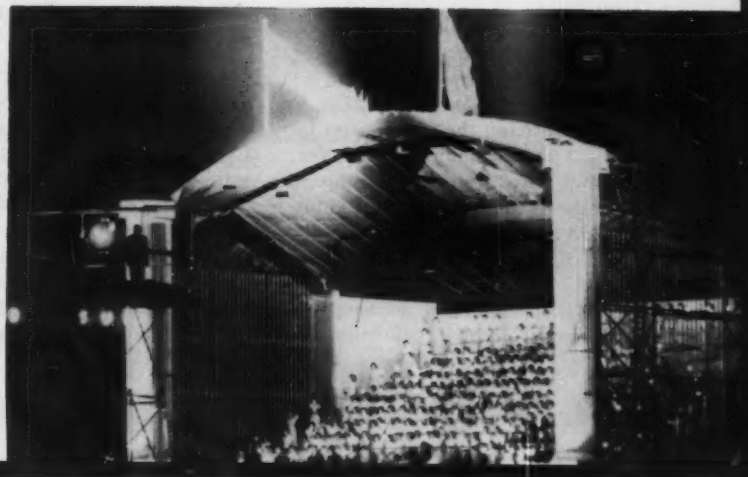
No tangible medium exceeds the Free World's use of lighting to reflect the warmth, fellowship, and spirit of the Christmas season. Though fuel oil may be in short supply in Brussels, the Boulevard Anspach glows with an electrical replica of the Zodiac. In Essen, more than 100,000 bulbs outline an Oriental motif. Philips of Paris is but one of many decorated shops in France. Vienna's main shopping center, the Mariahlifer Strasse, is again in bright dress this year. Carols by Candlelight, an annual Christmas Eve event in Melbourne, attracts as many as 70,000 persons. And Lord & Taylor's five-story Christmas tree in lights, above, typifies the gay holiday spirit of the U. S.

Lighting Around the World

London, England

Essen, West Germany

Melbourne, Australia



To Hold Industry Leadership, 'Keep a Step Ahead': Clark

The electric utility industry must "keep a step ahead" of technological developments to maintain its leadership.

This is the conviction of Newell A. Clark, recently elected president of the newly formed Merrimack-Essex Electric Co in Malden, Mass.

"The industry, through research and development, has to be a leader," the 62-year old, 6-ft president stated. This can help solve the pressing problem of "being ready, able, and willing to serve the public with any new device or by any method using electric service. This is our first duty," he said.

Clark, a veteran of 38 years experience with and for the industry, voiced the view of many utility executives when he observed: "A major problem today is financing for new plant and equipment. Our need is not the getting of equipment or manpower, but money at reasonable rates."

Clark is also head of Suburban Electric Co. Merrimack-Essex and Suburban are subsidiaries of New England Electric System. The two affiliates serve 240,000 customers.

After graduating from a Watertown, N. Y., business college, the personable president got a job working on switchboard construction of a steam station owned then by Turners Falls Power & Electric Co. Next, Clark did repair work at other stations, a job "I enjoyed a great deal," he recalled.

Following World War I service with the Army Engineers and a two-year stay with General Electric Co's engineering maintenance section, he joined Fall Mountain Electric Co at Bellows Falls, Vt. In 1926 he became general manager of the firm.

Clark held management posts in Rhode Island and Massachusetts until 1949 when he became principal officer of New England Electric System's utilities in the area north of Boston.

One of his main vocational interests is the development of forward-looking administrative and operating help. For himself, Clark has found business college training "a great thing to have." It has helped solve many problems, he said.

Utility Spending to Dip, Says SEC-Commerce

Public utilities expenditures for new plant and equipment in the first quarter of 1958 will maintain the downtrend that began the middle of this year. This is the outlook according to the latest Securities & Exchange Commission-Commerce Dept survey of business.

Included in the utility classification are telephone, water, sewerage, gas and electric organizations.

While the slide is common to other industries, the utility drop for the first three months of next year —about 2% below the current quarter—is less than for all industry, and estimated outlay is still well ahead of the first quarter of 1957.

The survey finds utilities will spend at a seasonally adjusted annual rate of about $6.48 billion in the first quarter. This is off from $6.62 billion estimated for this quarter and $6.64 billion in the third quarter. Actual estimated expenditure in 1957 will be $6.278 million compared with $4.895 million in 1956.

Power Companies' Budgets Are Up

Electric utilities are the big offset in the tapering investment based on McGraw-Hill's Dept of Economics' survey of '58 intentions picture, (EW, Nov. 11, p 127). Plans of investor-owned companies call for an 8% hike over a record-breaking '57 outlay of $4 billion.

The view for 1959 is a bit more clouded, though, for electric companies. In preliminary plans for that year, about 45% of them in McGraw-Hill's study said they'd be spending less than in 1958.

The SEC survey shows actual estimated expenditures by utilities for the first quarter 1958 will be $1,413 million, compared with $1,843 million in the current quarter and $1,205 million in first '57 quarter.

Electrical machinery and equipment makers also indicate a cutback. The survey finds they'll spend $124 million in the first quarter compared with $183 million estimated for the current quarter and $126 million spent the first three months this year.

Their total expenditures for 1957, including the estimated fourth quarter, will be $606 million, according to the survey. In 1956 it was $603 million.

4-Stage Plan Set By Carolinas Virginia, Inc

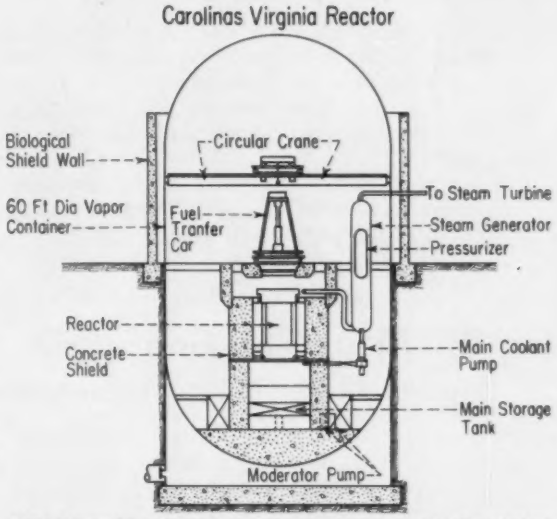
Program includes development of pressure tube, heavy water reactor; a 19-Mw prototype; possible construction of 200-Mw plant

Carolinas Virginia Nuclear Power Associates, Inc, a group of four power companies, has detailed a four-stage development program to produce nuclear power. The principal aspects include:

- Research and development of the pressure tube, heavy water moderated and cooled nuclear reactor plant.
- Construction of a prototype plant with 19-Mw (electrical) capacity to verify research and development and furnish data for evaluation of larger future plant.
- Operation of the prototype with various core and component designs.
- Possible future construction of a commercial plant of 200 Mw or larger capacity by one or more of the member companies.

Members of the corporation are Carolina Power & Light Co, Duke Power Co, Virginia Electric & Power Co, and South Carolina Electric & Gas Co.

The reactor shown here will be fueled with about 2% enriched uranium. Heat from the fission process is absorbed by a heavy water coolant and is directed to the heat exchanger. Steam is delivered to the existing plant's steam supply system to activate conventional turbines and generators.



SCE&G'S PARR SHOALS STEAM PLANT IS SITE OF PROTOTYPE

Target date for the plant is June 30, 1962. Westinghouse Electric Corp is developing the reactor. Stone & Webster Engineering Corp will act as consulting, design, and construction supervision agent. General Nuclear Engineering Corp will handle nuclear consulting.

Pre-operational costs and post-construction R&D costs will be borne by the Atomic Energy Commission, according to the group's proposal. AEC has also been asked to lend nuclear materials and heavy water. The power companies will pay $17.1 million for administration and coordination, conceptual design, program planning, engineering and design, construction, start-up and operation.

Homogeneous Reactor Proposed By Penn P&L, Westinghouse

A proposal to build a full-scale nuclear power plant has been filed with the Atomic Energy Commission by Pennsylvania Power & Light Co and Westinghouse Electric Corp. The plant would use an aqueous homogeneous reactor and have a 70 to 150-Mw electrical capacity. Cost of the over-all project, if it goes to 150 Mw, is estimated at $57 million, or $380 per kw.

The proposal first requests $7.3 million from AEC for research assistance during the 1958-59 pre-construction period. In addition, AEC would supply up to $18 million during construction and up to five years operation, provide fuel for the reactor's thorium-uranium cycle, and waive fuel use charges.

PP&L and Westinghouse have spent $5.5 million in developing the single-region type reactor. If they decide the project is not feasible after the pre-construction period, AEC aid will be repaid. Baltimore Gas & Electric Co is a recent member of homogenous reactor project group.

NUCLEAR NOTES

Shippingport capacity at year's end is expected to hit 60 Mw. Ultimate 100-Mw output is not expected until 1960 when second core goes in service.

Radiation exposure levels have been lowered by AEC to jibe with National Committee on Radiation Protection standards. Major change limits maximum permissible occupational exposure to an average of 5 Rems per year over worker's lifetime. Previous limit was 15 Rems.

Load Building a la St. Nick

Utah Power & Light Co is again providing free electricity for holiday lighting on city streets and parks in more than 100 cities and towns in its tri-state service area. Available from dusk to midnight, service is lighting about 50,000 lamps from Dec. 1 to Jan. 1.

Last year, UP&L distributed a 246,000-kwhr Christmas contribution to brighten 43,000 holiday bulbs in Utah, Idaho, and Wyoming.

For the Man Who Goofs . . .

To err has always been human. But now it's also insurable, at least by architects and engineers.

A relatively new type of insurance, which covers "errors and omissions" made by the architect or engineer, is getting wholehearted support from a number of professional societies. One such policy, endorsed by Consulting Engineers Council and offered by Fidelity & Casualty Co, covers:

- Negligent acts, errors, and omissions by the head of the firm and his employees. This applies to any engineer, architect, or company hired as subcontractor on a project for which the insured is responsible.
- Defense of the insured against claims.
- Mistakes made in supervision, if this supervision is a normal part of the insured's work.

Other professional groups backing similar policies are New York Assn of Consulting Engineers; American Institute of Architects, National Society of Professional Engineers, and New York Society of Professional Engineers.

Tardy But Trustworthy

Over 23 years ago, Dayton Power & Light wrote Jess Swackhamer asking him to pay his $2.93 electric bill. Which he did—a few weeks ago.

But he wrote the check for $3.50 and included no explanation of the difference. He may have intended it as interest, or maybe to cover the changing value of the dollar.

Whatever the reason, Mr. Swackhamer now has 57¢ credited to his account at the utility.

Aussies Halt Hydro Moss

New treatments to prevent plant growth in hydro station supply races are meeting success in Australia. Researchers tried incorporating elemental sulphur or certain copper compounds and sodium silicate surface layer in raceway concrete. At one plant where turbine water had been reduced 10% they've kept moss growth down to negligible proportions over a two-year period. The materials are toxic to moss but insoluble in water, which remains unpolluted, the researchers have discovered.

Mosaic Facelifting

A glass mosaic mural, nine feet high and 33 ft long, will be featured in the decorative scheme of the Seattle City Light building, now being remodeled and enlarged.

The mural, which will decorate the exterior front of the building, will be composed of figures and symbols representing the sun, moon, wind, and rain harnessed by man and converted into electrical power.

The mosaic will be made in Mexico. It will consist of thousands of pieces of glass tile which, when received in Seattle, will be imbedded in tile concrete on the building's supporting wall.

Power Restored at Kitimat

Five days after its transmission life line was cut by a rockslide, the aluminum city of Kitimat in northern British Columbia could look forward to a near-normal holiday season. A temporary transmission line, thrown around the Kildala Pass slide area, is supplying heat and light for the 14,000 townspeople.

During the interruption power was supplied by auxiliary generating units. These were supplemented by a 1,000-kw rail-mounted diesel generator supplied by the B. C. Power Commission.

Full production at Aluminum Co of Canada's giant smelter is expected to resume this week. Estimated loss to the aluminum firm exceeds $5 million.

Ssh . . . It's Rock-Splitting Time

As headlines about Sputnik fade, busy Soviet scientists make the news again—this time because of their "silent" rock-splitting explosions and their projected atomic railway locomotive.

Moscow reports a Leningrad scientist has devised a scheme to split any size rock noiselessly by running a high tension electric current through water. "No fragments are scattered" after the blast, city officials claim.

Meanwhile, a super railway is being planned which would have atomic locomotives capable of pulling trains weighing 50 to 60 times more than present haulage maximums. Goal: to link the east and west of the country.

Salute to National Electrical Week . . .

The Electrical Industry: How Big?

- **U. S. produces and uses 41.1% of the world's supply of electricity; Russia second with 11.2%**

- **Everybody is customer, more than half the U. S. population is indirect owner of the industry**

- **Electrical Industry spends more than one-fifth of all money spent by industry for capital expansion**

(In just seven weeks, the electrical industry will be celebrating National Electrical Week. Purpose of this article is to sketch out the dimensions of this vast business.)

The United States is far out front in the production and use of electric power. Latest figures available show that this country produces 41.1% of all electricity produced in the world. That is nearly four times as much as our closest competitor, Russia. The U. S. produces seven times as much electricity as Canada or Britain, and eight times as much as West Germany.

Behind the nation's clearcut superiority in this field is the vast and complex electrical industry which will sponsor National Electrical Week next February 9-15.

Wherever you look in the nation's homes, stores, factories, along its network of highways, and out in the rural areas, you're almost certain to see evidence of the products and services provided by the electrical industry.

Here are some broad measurements to give you a rough idea of the size and complexity of the electric industry.

Major segments: Among the chief contributors to the electrical industry are the electrical machinery and appliance manufacturers; the electric utilities; the whole electronics industry; the radio and television broadcasting industry; electrical contractors and maintenance men; electrical wholesale distributors; the communications industry; and engineering and construction firms.

Customers: Practically every man, woman, and child in the nation is a customer of the industry. The utilities furnish service to some 47.4 million residential customers, and the appliance industry has sold at least one radio and refrigerator to 96% of these customers. The telephone companies provide service for some 63 million phones—an average of one telephone for every three persons in the country.

Production: During 1957 the industry turned out a minimum of $56.2 billion worth of goods and services, accounting for more than one-eighth of all the goods and services produced by all business and industry in the U. S. during 1957.

Growth: Also during 1957 the electrical industry put $8.2 billion into expansion of its plant and buildings—some 21.2% of all money spent by all industry for expansion. And during the year ahead the industry generally will increase its capital spending despite plans by total U. S. industry to level off or cut back capital spending.

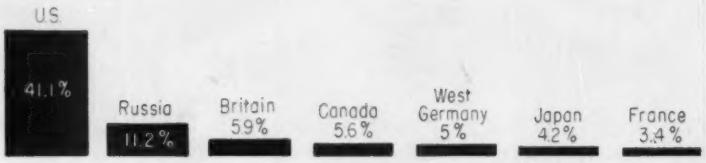
Employment: The industry, at a minimum, employs one out of every 20 workers in the country.

Ownership: The electrical industry has nearly 7 million direct owners and some 97 million indirect owners.

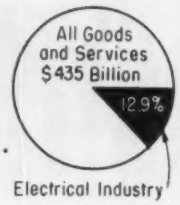
For a more graphic description, please turn to the next page.

The Electrical Industry at a Glance . . .

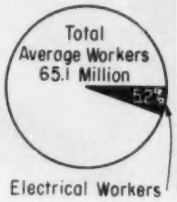
It produces 41.1% of the world's electric power . . .



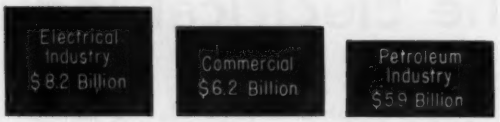
It accounts for 12.9% of all goods and services provided by all U. S. business and industry . . .



It employs 5.2% of the workers in the country . . .



In 1957 the industry spent $8.2 billion for capital expansion—21.2% of the total industry capital expenditures in the U. S.



It provides electric service for 47.4 million homes and apartments

It has installed an average of 1 telephone for every 3 persons in the country
It has manufactured and placed into service radios in 96% of the nation's wired homes and refrigerators in 96.2% of the homes.

The electrical industry has nearly 7 million direct owners.
Over half the total U. S. population is an indirect owner of the industry.

The Electrical Industry—1957

Segment	Value of Goods & Services ($ Millions)	Employees (Thousands)	Number of Companies	Capital Expenditures ($ Billions)	Shareholders (Thousands)
Electric Utilities	9,300	348	3,600	4.65	3,800
Electrical Machinery Manufacturers	22,200	1,210	1,008	.653	810
Electronics Industry	12,000	568	8,106	.....	500 est.
Electrical Wholesale Distributors	1,400	108	7,000	.....	.....
Electrical Contractors	3,300	210	19,500	.....	.....
Maintenance	1,010	165	.....	.....	.....
Communications	7,000	771	4,960	2.9	1,630
Total	56,210	3,380	44,174	8.203	6,740

What Is True Cost of Coal?

Mechanical engineers discuss this question in New York, and how to pay for and handle coal at generating plants

Coal, number one source of energy for utility power generation, was scrutinized closely at the American Society of Mechanical Engineers' annual meeting Dec. 1-6 at New York. Opinions were expressed on how to determine the true cost of burning different types, how much to pay for coal, and how to handle it.

That coal can and should be purchased on a cents-per-million-Btu basis, was disputed by H. G. Lammers, Appalachian Coal Inc., who argued that this view was based on the false premise that the value of all coals is intrinsically related to their heat content. In analyzing the operating and maintenance costs of 200 generating stations, he showed that considerable progress has been made in reducing boiler plant costs.

His analysis showed that these costs in modern (in service since 1950) plants were about 50% lower than in plants placed in service before that date. Lammers said that other economies can be effected by operating at high load factors, by increasing station capacity and automation, and by using quality coal. Stressing the last point, he contended that the use of quality coal reduces coal-burning costs because it:

1. Increases capability and availability.

2. Allows a reduction in plant facilities.

3. Reduces transportation and handling costs.

4. Reduces maintenance and power consumption.

5. Reduces air pollution.

6. Increases boiler efficiency.

Lammers compared the costs of burning 11,000 and 13,401-Btu coal in a 160-Mw unit, operating at 80% load factor and consuming 500,000 tons a year. He gave the cost of 11,000-Btu coal as $7 per ton. Factoring in the advantages from the use of the better coal, he declared that there was a $1.16-per-ton difference in the cost of burning the two types.

The purchasing policy of Northern Indiana Public Service Co contains a bonus penalty method of purchasing coal, based on the company's belief that the true value of coal to the consumer increases with increased Btu per lb and decreases with larger amounts of moisture, ash, and sulphur. Suppliers get a bonus when their coal is of higher quality than they had guaranteed and, conversely, they are penalized when the coal doesn't meet specifications.

In evaluating the costs affected by variations in coal quality, this utility's engineers divide the costs into three classes:

1. Cost of handling coal and ash, including labor, mechanical maintenance, and power costs.

2. Changes in heat losses.

3. Cost of replacing power resulting from boiler outage time for maintenance, or reduced capacity because of combustion difficulties.

After considerable study, a decision was made to relate these costs to loss or gain in the Btu value of coal, and to use the Btu difference as a correction to the as-received Btu per lb.

A paper by R. M. Schahfer and F. H. Strout of Northern Indiana

Btu Corrections per Percent Variation of

	Moisture	Ash	Sulphur
Mechanical losses	20.1	37.2	20.1
Heat losses	16.0	21.3	79.3
Power replacement	25.0	25.0	25.0
	61.1	83.5	124.4

For ease in application the actual figures used are: moisture 60 Btu per percent, ash 80 Btu per percent, and sulphur 100 Btu per percent.

Here is How One Utility Purchases Coal

A standard form is sent each month to each vendor giving the as-received analysis for the month's coal shipments, and the debit or credit for deviations from the guaranteed analysis.

The following calculation shows the method used to obtain such debit or credit:

Guaranteed Standard Analysis	%	As-received analysis %	Difference in %	Rate Btu per %*	Actual Amount in Btu
Moisture	6.7	4.41	2.29	60	137 Bonus
Ash	8.1	9.83	1.73	80	138 Penalty
Sulphur	3.0	3.58	0.58	100	58 Penalty
Btu content	12,400	12,599			199 Bonus
					140 Net Bonus
Mine price	—	$3.50			
Freight+tax	—	3.14			
Delivered cost	—	$6.64			

Adjusted Btu = 12,540 (12,400+140)

Tons delivered—5,450

Adjustment-per formula: $\$6.64 \times \frac{(12{,}400 - 12{,}540)^{**}}{12{,}400} = 7.5¢/\text{Ton bonus}$

Month's Adjustment = 5,450 × $.075 = $408.75 Bonus.

* If the deviation from standard is less than 0.5%, no adjustment is made.

** If the difference between the standard and the adjusted Btu is less than 100, the debit or credit is zero.

Public Service Co, and G. W. Land, Truax-Traer Coal Co, detailed the method used in arriving at these correction factors. The calculated corrections are shown in the table on p39.

The procedure for using the method works like this. Bidders are required to submit a guaranteed analysis of the coal to be supplied. A calculated mean analysis is prepared from the submitted data. The bids are adjusted in accordance with the as-received correcting factors. The resulting cents-per-million Btu figures are then used as one of the criteria of the coal to be purchased.

Monthly adjustments in the per-ton price of coal delivered by the successful bidder are made in a similar manner. The accompanying example illustrates the method.

The utility's experience with the method has been satisfactory because it is relatively simple and accurate. Quality coal has improved in the four years during which the bonus-penalty method has been used. The average Btu per lb of coal received last year was the highest in the company's history.

A successful coal handling system, incorporating automatic intermittent feed with outdoor storage, aroused the interest at the meeting. Details of the system were described by R. A. Baker, Public Service Electric & Gas Co. The equipment described by Baker was put in service for the Burlington unit No. 7.

Because the equipment had to be incorporated with coal-handling facilities of the existing station, it was not possible to get a true comparison of its cost with that of other systems. PSE&G engineers are confident that at an entirely new installation the system would be lower in first cost than systems previously used. In addition to potential capital savings, this new method removes some hazards of storing large quantities of coal indoors by going outdoors.

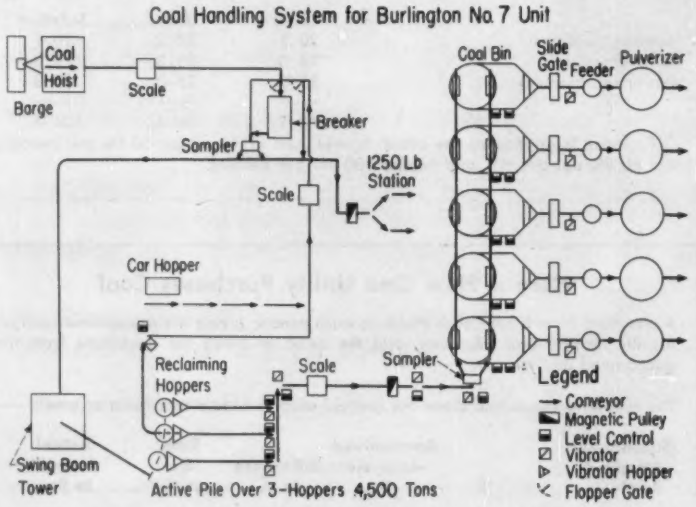
Electronic probes for sensing the level of coal in 4-hr bins associated with the boiler's pulverizers are the heart of the system. A large active storage pile in the center of a long-term storage pile over three ground-level reclaim hoppers provides coal for unit No. 7. These storage-pile hoppers feed a series of conveyor belts controlled from the level in five 4-hr bins above the pulverizer feeders. This results in automatic intermittent delivery of coal to the feeders. The system is under supervision of the control room operator at all times.

The active storage is supplied on weekdays with river-borne coal. But should there be an interruption to this supply, bulldozers and tractors can maintain the pile from the long term pile. The active storage is sufficient to supply the unit's requirements without the need of coal handling crews over the weekend. Details of the system operation are given with the accompanying schematic flow diagram of the coal handling system.

Other power plant experience of Public Service was related by R. I. Smith, who indicated that two years' experience with the ammonia-hydrazine method of chemical conditioning of high-pressure boilers has been successful. PSE&G adopted it to reduce corrosion in the preboiler cycle and minimize the possibility of turbine deposits by eliminating the addition of solids-forming chemicals to the boiler water.

The treatment has been used on six boilers, two at the Kearny station, one at Burlington, and three at Linden. Drum pressures range from 2,327 to 2,553 psi. The ammonia-hydrazine method was first used with the Kearny No. 7 unit in March 1953.

Inspections of the turbines at Kearny and Burlington made since adoption of the ammonia-hydrazine treatment show the units to be practically free of deposits. No boiler-tube failures attributed to chemical treatment, or lack of it, have occurred in any boiler operating with ammonia and hydrazine.



Here is how the system works:

A hoist on the dock delivers coal brought by barge to a swing boom tower via a 42-in. conveyor-belt system. The swing boom tower discharges coal to one of three active storage piles above concrete reinforced reclaim hoppers. From these, coal is carried by an automatic conveyor system to the five coal bins of unit No. 7. Each bin serves one pulverizer 4-hr at full load. The system handles and weighs coal for No. 7 boiler on cycle controlled by high-low level devices in the bins.

Three belt feeders are located one under each of the three storage-pile reclaim hoppers. Each is 36-in. wide, has a capacity of 100 tons per hr, and feeds a 48-in. belt which carries the coal to the bins. As the nominal rating of the system is 100 tons per hr, only one feeder is required at any time for unit No. 7. The selection of the feeder is made by the control room operator. The 48-in. feeder may be used to supply the other units in the station.

Westinghouse Shows How to Haul a Giant

Meet the Schnabel car, newest way to ship giant transformers. Gimmick: The transformer serves as the middle section of the car (EW, March 25, p 132).

Westinghouse Electric Corp imported the idea from Germany, and added several major innovations. Pictured here is the Schnabel car's maiden U. S. shipment, a 200,000-kva autotransformer headed for Ohio Power Co's Kammer plant at Captina, W. Va., from Westinghouse's Sharon, Pa. transformer division.

Why the new car design? Take a close look. The transformer is shipped in one piece, because the Schnabel car carries it a bare six in. above the rails. A conventional car would carry it 24 in. higher. You would have to build the transformer with removable top sections for shipment (an expensive proposition), take the risk of having the open unit exposed outdoors during assembly.

The Ohio Power unit is big—it weighs 412,000 lbs assembled, measures 29 ft high, 30 ft long. The Schnabel car will handle up to 500,000-lb units in one piece.

Here's how it works.

Each car half consists of an underframe with trucks and a truss. The truss, attached to the load by pins, acts as a cantilever, concentrating the weight at the center of the underframe.

A combination of offset pivots and traversing load center (a roller bearing nest resting on a lateral cylindrical rocker bearing) add flexibility. The cars will haul 28-ft-long units over the same track grades and curves as a standard 50-ft box car.

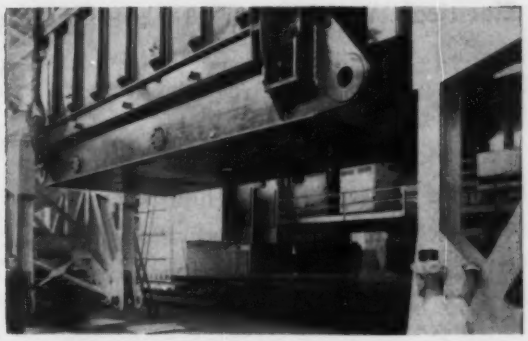
Self-Contained Cars Have Built-in Jacks

The cars are completely self-contained. Once you get the transformer lined up on the track, built-in hydraulic jacks maneuver each truss into position.

Closest to the load, four individually operated jacks work from the underframe. They are midway between the pin points (where the load is attached) and the truss' center of gravity. Raising and lowering these jacks manipulates the truss to engage the hooks or pin with the load.

Now the other set of jacks comes into play. They are at the rear of the truss, and, like the forward set, work from the underframe. As they are raised, they lift the entire load and truss, causing the truss to close against the load. At the destination, the operation is reversed. The forward jacks extend to take the load, the rear jacks retract, and the forward jacks are manipulated to disengage the load.

For the homeward trip, the two car halves hook together.



At Westinghouse, overhead crane lowers transformer between trusses to approximate position. Truss jacks will then manipulate truss so pins can be slipped in

At destination, men raise rear (100-ton) jacks to lift truss and load, slip cribbing under. Extending forward (30-ton) jacks and retracting rear ones lowers load

Transformer is on cribbing, free of trusses. Men first had manipulated front jacks, then knocked out pins. The transformer will be skidded off the track

Hooked together, Schnabel cars can return to plant over the fastest route. They fit within the AAR diagram for a car with a 41 ft, 3 in. chord lengths

Electrical World Survey Reports on . . .

Power Transformer Operating

Tells How 84 Systems. . . . .

- Load Units Beyond Their Rating
- Look at Two-Step Reduction of BIL
- Accept Standard Impedance Units
- Use Load Tap Changing Equipment
- Provide Spare Transformer Capacity
- Decide What Transformers To Scrap
- Use Mobile Substations
- Rate future transformer developments

Dan Braymer, Assistant to the Editor, Electrical World

The pattern of power transformer operating practices on electric utility systems of the United States today is reflected in a survey conducted by Electrical World.

In scope the survey embraces the practices of 84 power systems representing over 77% of the industry on a peak basis. Returns reflect operations involving 260,875,000 kva of power transformers in more than 18,000 substations associated with generating stations, transmission, and distribution systems.

Power systems participating have peak loads ranging from 76,000-kw to 5,697,000-kw, 21 have peaks over 1,000,000 kw. Some serve areas as small as 127 sq miles, the larger ones 200,000 sq miles or more.

Among the conclusions drawn from the survey are these:

1. In both normal and emergency loading practice, utilities generally do not adhere closely to present ASA Loading Guides. Loading practices lack consistency.

2. Most systems are not prepared to accept a two-step reduction of transformer basic insulation levels.

3. Use of non-standard power transformer impedance at generating station substations as well as transmission and distribution substations is the exception rather than the rule. Most systems accept standard impedance.

4. Use of load tap changing equipment with power transformers may be expected to increase slowly but steadily at distribution substations and somewhat more gradually at transmission substations.

5. Confidence in the forced cooling equipment of transformers was indicated by the fact that as many as one system in four has transformers without self-cooled rating (FOA, FOW) at unattended substations.

6. Mobile substations are widespread. Their use has had the effect of increasing three-phase transformers on systems and of permitting single-phase banks without spares.

7. Most systems do not provide spare transformers at important generating stations. Spare transformers at transmission substations are much more common.

8. Age, physical condition, and cost of reconditioning old power transformers predominate as criteria for scrapping such units.

9. Use of single-circuit,integral-type unit substations may be expected to decline substantially.

10. In order of preference, interest in future transformer developments, aside from lower price, are these:

Lower noise level
Lower losses
More standardization
Easier maintenance
Lighter weight, smaller size
Easier installation
Lower impedance
Extension of non-flammable construction

Power Transformer Survey Covers 77% of the Industry

General	
Number of power systems reporting	84
Total of individual system peaks—kw	78,744,000
Annual industry peak load—kw	102,400,000
Percent of industry represented	77.2%
Average of system peaks reported—kw	972,000
Median system peak—kw	602,000
Highest individual system peak—kw	5,697,000
Total power transformer capacity reported—kva	260,875,000
Ratio of transformer kva to peak load kw	3.3
Number of systems reporting size of largest transformer in use	80
Range of maximum transformer sizes in use—kva	9,000–400,000
Number of transformer ratings reported as max on system	46
Median of maximum transformer ratings in use—kva	70,000
Generating Station Substations	
Total transformer kva in generating station substations	89,692,000
Number of generating station substations represented	917
Average generating station substation transformer kva	97,800
Transmission Substations	
Total transformer kva in transmission substations	87,129,000
Number of transmission substations represented	2,047
Anerage transmission substations transformer kva	42,564
Distribution Substations	
Total transformer kva in distribution substations	84,054,000
Number of distribution substations represented	15,466
Average distribution substat.on transformer kva	5,435

Practice

General character of the 84 power systems surveyed is summarized in the accompanying table. Charts (right) show the pattern of peak-load distribution among systems as well as the average size of substations associated with generating stations, transmission (bulk power), and distribution systems. Also charted is the pattern of maximum power transformer size (max nameplate rating) in use among systems surveyed.

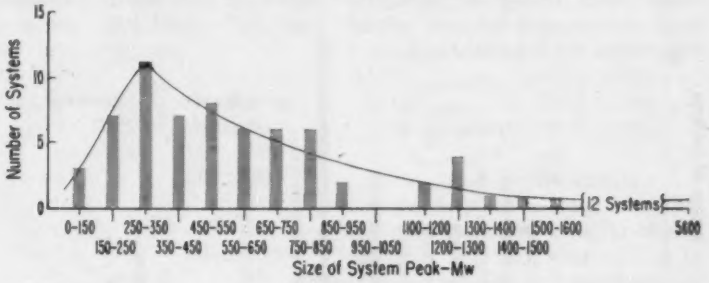
Question: In normal operation do you load power transformers above maximum nameplate rating in accordance with ASA Transformer Loading Guide C57.92?
Answer: Only 53.5% (44) of the 82 systems answering this question follow the ASA recommendations in loading power transformers above nameplate rating. The other 46.5% (38) flatly said they do not. Two did not answer the question. But all except five of 21 systems with peaks of more than 1 million kw adhere to the ASA guide.

Q: At distribution substations, what power transformer overloading limits do you allow before resorting to load relief?
A: Of 67 power systems answering, 63% (42) limit load to some combination of oil and/or winding temperature. Another 34% (23) base their overloading limits on a percentage of transformer rating alone while 3% (2) limit load to that calculated to give 1% loss of life per day during long emergencies.

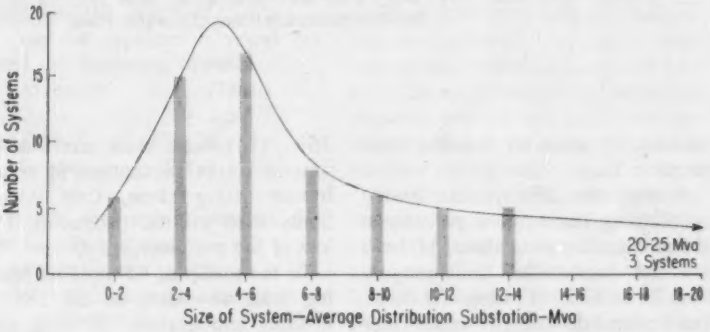
Among 42 systems limiting load according to oil and/or winding temperature, 28 specify a top-oil temperature limit in the range from 65 to 115C, and 18 hold to the range from 75 to 85C. Five impose a top-oil temperature *rise* limitation ranging from 35 to 55C. Only nine impose no top-oil temperature limit at all.

Among these 42 systems, 21 limit winding temperature in emergencies to the range from 95 to 150C; 13 hold winding temperature to 105C. Six limit winding temperature rise to the range from 55 to 85C. The re-

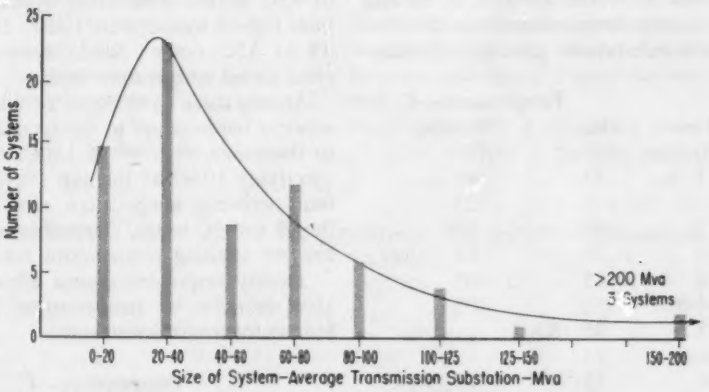
84 Systems With Peaks of 78,744 Mw Have . . .



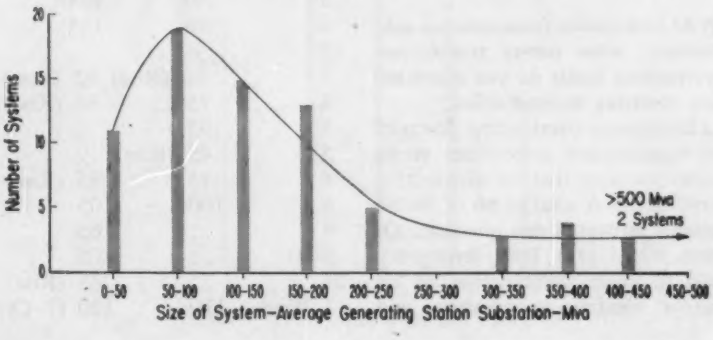
84,000 Mva of Transformers at 15,466 Distribution Subs . . .



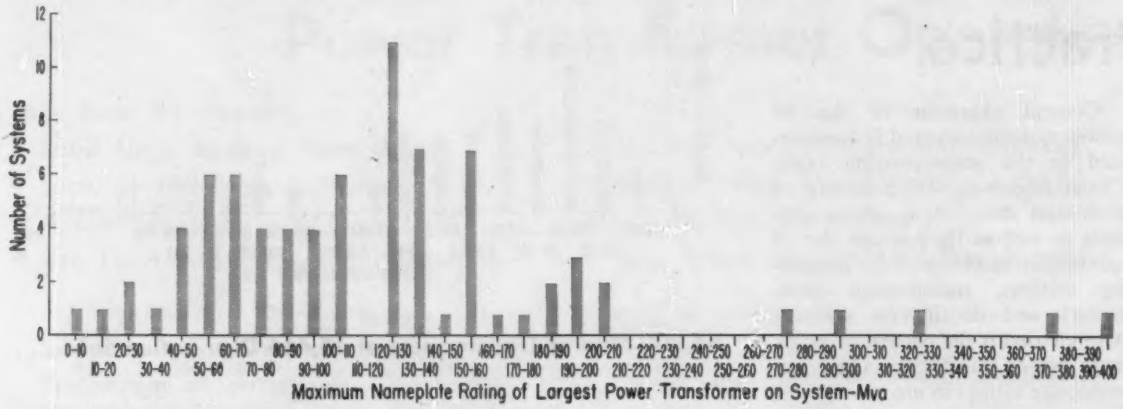
87,000 Mva at 2,047 Transmission Subs and . . .



90,000 Mva at 917 Generating Station Subs



Maximum Power Transformer Sizes in Use Range Up to 400,000 Kva in 46 Different Ratings



maining 15 gave no winding temperature limit.

Among the 23 systems basing overloading limits on a percentage of transformer rating alone, 11 have a winter overloading limit ranging from 25 to 33% of rating. Of these, four systems de-rate this winter limit from 14 to 25% for summer conditions.

A group of 13 respondents who cited allowable duration of oil and winding temperatures for distribution substations gave these values:

	Temperature—C	
Time	Oil	Winding
20 min	100	150
1 hr	85	105
2	105	125
2	80	95
3	75	85 (Rise)
4	85	105
4-6	..	105
5	45 (Rise)	..
5	95	..
6	75	85 (Rise)
8	100	105
8	115	130
8	..	105

Q: At bulk power (transmission substations), what power transformer overloading limits do you allow before resorting to load relief?

A: Emergency overloading practices for transmission substations varies somewhat from that for distribution substations. A total of 66 of the 84 systems answered this question. Of these 62% (41) limit emergency load to some combination of oil and/or winding temperature, and 36% (24) base their overloading practice on a percentage of transformer rating alone. One system limits load to that producing 1% loss of life per emergency.

In the group of 41 systems limiting load according to oil and/or winding temperature, 29 limit top-oil temperature to the range from 70 to 110C, 15 holding to the range from 75 to 85C and 22 to the 70 to 95C range. Five other systems limit top-oil temperature rise to the 33 to 55C range. Seven systems cited no oil temperature limit.

Among these 41 systems, 24 limit winding temperature in emergencies to the range from 95 to 150C; 12 specifying 105C as the top. Seven limit winding temperature *rise* to the 55 to 85C range. The other ten cite no winding temperature limit.

Twenty respondents gave allowable duration of temperatures as follows for transmission subs:

	Temperature—C	
Time	Oil	Winding
20 min	100	150
1 hr	85	105
2	95	105
2	105	125
2	90	..
4	50 (Rise)	62 (Rise)
4	75	85 (Rise)
5	95	..
5	45 (Rise)	..
6	75	85 (Rise)
8	100	105
8	..	105
8-10	..	105
24	..	65 (Rise)
1 Week	110	120 (7 Cy)
Continuous	45 (Rise)	65 (Rise)
Cont	35 (Rise)	55 (Rise)
Cont	Design Limit	105
Cont	70	100
Cont	..	95

It is among the 24 systems that base emergency overloading limits on a percent of transformer rating that transmission substation practice differs most from distribution substation practice. At transmission substations 25% (6) of the 24 systems adhere to nameplate rating, 33% (8) hold percent overload in emergencies to the range from 10 to 25% of rating, and 25% (6) follow the ASA loading guide.

Q: What, if any, is the largest power transformer nameplate rating you **are willing to install at: Generating stations? Bulk Power Substations? Distribution Substations?**

A: For the 70 systems represented in answers to this question it is clear that the size of generators is the dominant influence limiting size of power transformers installed at generating stations. Considerations of system design, reliability and transportation facilities rule in the case of transmission substation and factors of short-circuit duty, feeder capacity and reliability predominate where distribution substations are concerned.

In the case of generating station substations 34 systems regard generator size as a factor influencing maximum power transformer to be installed; 13 cited shipping and handling facilities; two cited system

reasons, and one "maintenance" as factors in their specific restrictions. 20 systems gave no answer. Size limits cited were these:

No. Systems	Mva Rating
3	100
6	100-150
6	150-200
5	200-300
3	300-400

In the case of bulk power (transmission) substations, 26 systems cited factors of economic system design and reliability as establishing the limiting power transformer size they would install; 15 mentioned transportation limitations. Six said that maximum size depends on size of spares and four that maintenance was the controlling factor. No answer was given by 12 systems. Size limits cited were these:

No. Systems	Mva Rating
1	Under 10
19	10- 50
8	50-100
14	100-200
4	200-300

In the case of distribution substations 31 systems said that short-circuit duty had the controlling influence over maximum power transformer rating installed; 14 cited feeder capacity and reliability; seven transportation, five economic design, three size of spares, and two maintenance. Eight gave no definitive answer. Size limits cited were these:

No. Systems	Mva Rating
17	Under 10
10	10
4	12.5-20
9	20
3	25
7	over 25

Q: What type of transformer protection do you employ against transient overvoltages? Gaps? Lightning Arresters? Both? Neither?

A: The 84 systems surveyed reported the following practice

Arresters	62	(74%)
Gaps	3	(3.5%)
Both	18	(21.4%)
Neither	1	(1.1%)

Q: Where are such protection devices usually installed?

A:

At transformer terminal	32
At transformer terminal and substation entrance	14
At transformer terminal, substation entrance, and bus	16
At transformer terminal, and bus	11
At bus only	6
At substation entrance only	3
Other locations	2
Systems responding	84

Q: Would you recommend the installation of power transformers having two-step reduction in basic insulation level (BIL) if applicable?

A: No 47 (56%)
Yes 28 (33%)
No comment.. 9 (11%)
84 (100%)

Reasons given for not accepting two-step reduction of BIL clearly reflected a feeling that a risk to both equipment and reliability of service is involved in widespread use of two-step reduction today.

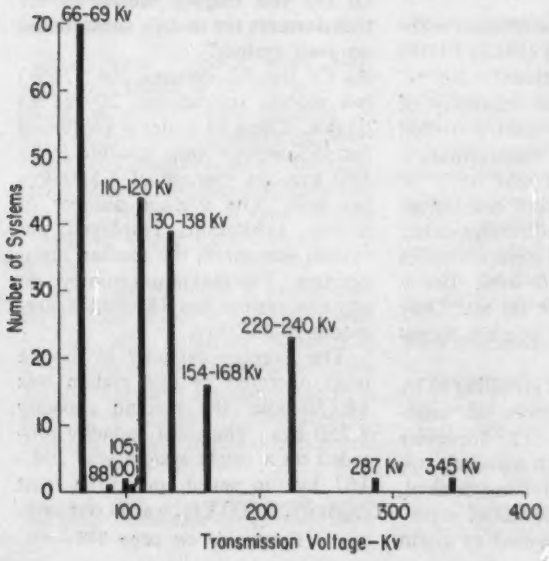
Out of 37 who explained their opposition, 60% (22) said that the savings do not justify the risk at voltages in use (110 to 115 and 138 kv); 16% (6) said dynamic and switching overvoltages are too high; and another 16% felt the industry does not yet have enough experience.

On the other hand, among those favoring two-step reduction of BIL, 57% (16) indicated willingness to accept it for 230-kv and higher; 14% (4) for 161 kv and up, and 14% (4) for 138-kv and up. Two systems indicated acceptance for 115 kv and higher; one okayed it for 100 kv and up.

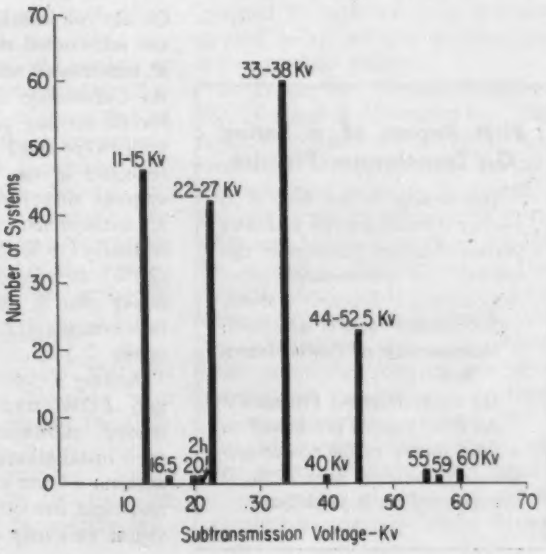
Q: What transformer protection is employed against short circuit? Breakers and relays? Fuses? Reclosers?

A: 35% (29) of systems are using all three devices to protect power

Transmission Voltage Range—66-345 Kv . . .



33 Kv Common for Subtransmission



transformers against short circuit. An exactly equal number use breakers and relays, and fuses. Another 23% (19) confine short-circuit protection to breaker and relay systems exclusively. About 5% more use breakers and relays and reclosers.

Q: Do you use pressure relays for: Primary protection? To supplement differential relays only? Alarm only? Or not at all?

A: A significant proportion, 38% (32), of the 84 systems do not use pressure relays at all. However, one out of four (21) use them for alarm only. Another 20% use pressure relays to supplement differential relays only; four systems use them for primary protection.

Q: Do you require non-standard transformer impedance at: Generating station step-up substations? Bulk power substations? Distribution substations?

A: Answers showed clearly that very little use is made of non-standard transformer impedance today at the three types of substations. 83% of systems use standard impedance at generating station substations; 77% at bulk power substations; and 82% at distribution substations.

In all, 85% (72) of systems expect to continue their practice with regard to standard transformer impedance for the next five years.

Q: Do you now provide load tap changing equipment for power transformers at: Generating stations? Bulk-power (transmission) substations? Distribution substations?

A: Load tap changing transformers are overwhelmingly popular for bulk power distribution substations but not for generating stations. Their operators apparently prefer to adjust voltage by changing machine excitation. Here's how the 84 systems answered:

At Generating Stations:

62 (75%) said "No"
13 (15.5%) said "Sometimes"
4 (4.75%) said "Usually"
4 (4.75%) didn't answer

At Bulk Substations:

22 (26%) said "Yes"
12 (14.4%) said "Usually"
32 (38%) said "Sometimes"
12 (14.4%) said "No"
6 (7.2%) didn't answer

At Distribution Substations:

19 (22.25%) said "Yes"
25 (30%) said "Usually"
25 (30%) said "Sometimes"
11 (13%) said "No"
4 (4.75%) didn't answer

In all, 88% (77) of the 84 systems expect no change in the application of load tap changers at generating stations five years hence. But at bulk power substations 24% (20) expected their use to go up; 67% (56) said there would be no change. At distribution substations 35% (27) expect an increase in use of load tap changers five years hence but 61% (51) expect no change in their use pattern.

Q: Do you install transformers without self-cooled rating (FOA, FOW) at unattended substations?

A: Confidence in the reliability of forced cooling equipment provided with FOW and FOA transformers is reflected in the fact that 39% of systems surveyed install transformers without self-cooled ratings either regularly (19%) or in some instances (20%) at unattended subs. But a husky 58.5% do not do so. Only two systems did not commit themselves (2.5%).

Among 33 systems installing FOA and FOW transformers at unattended substations, 12 supervise such installations with traveling operators; 14 use supervisory control, and eight use other forms of supervision variously described as alarm circuits, automatic trip, "relays," "protective equipment," a local operator. One system uses no supervision.

Q: How should power supply to transformer auxiliaries, such as cooling fans, oil pumps, load tap changing, and other devices, be provided?

A: Separate distribution transformers on the substation bus..... (68%) 57 systems
Separate distribution transformer served by unit itself..... (31%) 26 systems
Built in power supply..... (25%) 21 systems
Separate standby power supply.... (14%) 12 systems
External system source..... (12%) 10 systems

Q: If the main power transformer is "down" should FOA and FOW auxiliaries be kept going by an external source or sources?

A: "No"—56 (67%)
"Yes"—21 (25%)
"No opinion"—7 (8%)

Q: Do you provide spare transformers at: Important generating stations? Bulk power substations?

A: Over three-quarters of systems surveyed do not provide spare transformers at important generating station substations and only one out of two systems surveyed provide spares at bulk power substations. Systems were virtually unanimous in saying they did not expect to change practice in this regard.

Q: Do you employ mobile power transformers (or mobile substations) on your system?

A: Of the 84 systems, 64 (76%) use mobile substations; 20 (24%) do not. These 64 systems accounted for 195 mobile units totaling 892,560 kva, an average of 4,500 kva per unit. The average number of mobile substations employed per system was three; the median number two. The maximum number on any one system was 18 units, aggregating 24,117 kva.

The average capacity in mobile units operated by one system was 14,150 kva; the median capacity 8,750 kva. The most capacity provided on a single system was 204,167 kva in seven units; the least capacity, 2,000 kva, was in one unit.

(*Continued on page* 97)

First Report of a Series On Transformer Practice

This article is the first of a series dealing with various phases of power transformer operating and maintenance practices among U S power systems.

Subsequent reports will treat:

Maintenance of Power Transformers

Oil Reconditioning Practices

All three reports are based on a field survey of 84 power systems representing over 77% of the industry on a peak basis.

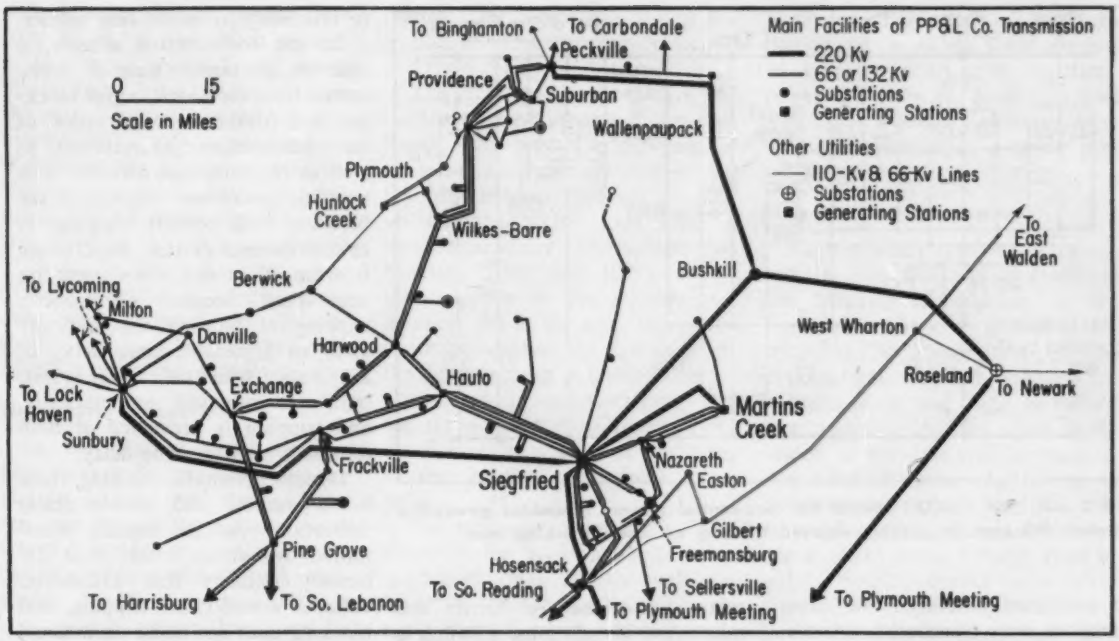


FIG 1—MARTINS CREEK-SIEGFRIED LINE is major outlet for power from No. 2 generator at Martins Creek Station. High-speed audio-tone relaying on this line guards against instability and fault damage and permits high-speed reclosing

Audio Tone Protects 220-Kv Link

Audio-tone relaying using pilot wires provides reliability and versatility at lowest cost of five schemes

J. A. G. **OEWEL**, Control Equipment Engineer, Pennsylvania Power & Light Co, Allentown, Pa.

A. J. **BURLESON**, Electric Utility Sales, Westinghouse Electric Corp, E. Pittsburgh, Pa.

Audio-tone relaying using pilot wires was found to be the most reliable, economic, and versatile of five methods for protecting the Martins Creek-Siegfried line, the relatively short (23-mile) but very important 220-kv link in Pennsylvania Power & Light Co's 220-kv network.

This link provides a major outlet for the 320-Mw Martins Creek Station into Siegfried Substation, a terminal on the Pennsylvania-New Jersey-Maryland Interconnection. A map of a portion of this tri-state network, illustrating the location and importance of the 220-kv line, is shown in Fig 1.

Analysis of protective relaying for the Martins Creek-Siegfried line revolved around the need for high-speed relaying as a precaution against instability and fault damage and to permit high-speed reclosing. Continuity of service is essential. A related problem was automatic tripping of one unit at Martins Creek. With station generation at or near full capability, permanent loss of the 220-kv link would require that generation be considerably reduced to remain within the capability of the remaining 66-kv ties to the PP&L network.

Five Methods Considered

Investigation revealed that the following relaying methods were applicable for protecting the 220-kv link:

1. Ac Pilot Wire: The 23-mile line appeared to be too long for pilot-wire relays. In routing telephone cables, the circuit would be much longer than 23 miles. And its resistance and capacitance would greatly exceed allowable limits.

2. Conventional Distance Relays: This method, without some means of comparison between terminals, does not give full high-speed line protection. The disadvantage of slow ground relaying could be lessened through use of a distance ground relay scheme to improve relaying speed greatly.

3. Power-line Carrier Relaying: With the use of distance relays, this scheme appeared to be a good answer. But because of crowded carrier spectrum space, it is desirable to limit applications to long lines. Cost and labor of coupling at 220 kv, as well as the high-current line traps involved, made the installation quite expensive. For a possible saving in spectrum space, frequency-shift power-line carrier was considered, but the cost was the same as for conventional carrier.

4. Microwave Relaying: Although this method does not use the power line as a channel, the cost of microwave generally limits its use

Adapted from papers presented before the Relay Committee, Pennsylvania Electric Association.

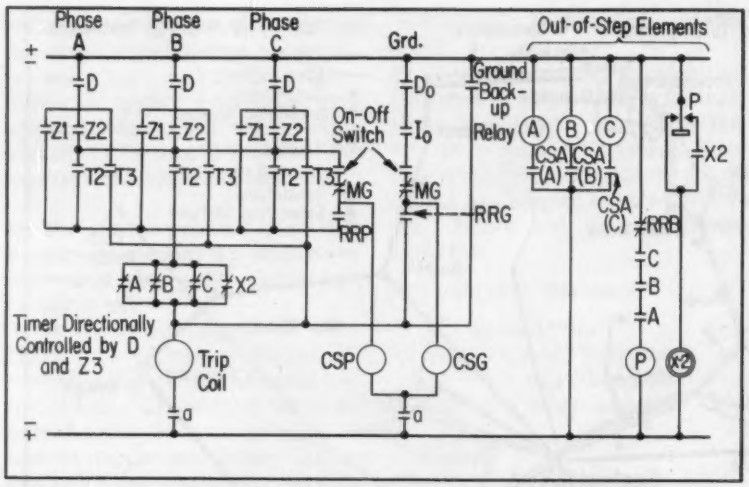


FIG 2—DC TRIP CIRCUIT control for tone-control scheme resembles power-line carrier. MG contacts prevent delayed tripping on loss-of-blocking tone

to combined functions. No other functions were considered.

5. Audio-tone Relaying using Pilot Wires: Comparatively new for distance relaying is the use of tones in the audio spectrum over pilot wires. Relaying schemes employing these channels have the advantage of continuous supervision, which is not possible in the standard carrier scheme. Use of tone-transfer tripping was not applicable owing to the difficulty of setting ground relays because of variable reach under different generating conditions.

Saving Exceeds $15,000

Use of duplex audio tones over leased telephone lines is economical for short lines. Estimates showed that a saving in capital investment exceeding $15,000 could be realized over power-line carrier. Because this figure is adjusted for an equivalent capitalization corresponding to annual rental of the leased line, actual saving in capital investment is greater.

Relays in tone-controlled method are identical with those on power-line carrier installations, except for a minor difference in the carrier auxiliary relay. This unit has a more sensitive holding coil and a time-relay for coordination purposes. Conventional high-speed carrier ground relaying could be used with slow-speed relays for backup protection.

Thus the tone-control relaying appeared to be the best solution. Because this scheme uses distance relays like those for carrier and microwave installations, a switch to either of these channels would incur almost no loss in investment. Continuous supervision and impassivity to tripping on extraneous voltages make tone relaying more reliable than the usual pilot wire and equal in reliability to power-line carrier.

In the tone-control scheme, a different frequency tone is transmitted from each location for blocking and continuous supervision of both transmitters and receivers, as well as the telephone circuits. For tripping conditions, removal of the blocking tone permits tripping, as in conventional carrier. Supervision is arranged so that when tones are interrupted because of trouble, tripping is blocked automatically after an adjustable time delay of 2 to 3 sec. When either tone is lost, both are removed automatically, and tripping is prevented at both terminals after the time delay.

Besides automatic blocking, there is an audible and visible alarm indication. As the signals transmitted are audio tones, it is extremely unlikely that extraneous voltages would cause tripping, and blocking does not occur on internal faults, unless the frequency of extraneous voltages matches one of the blocking tones.

Short-circuited or open telephone channels, unless occurring almost simultaneously with a nearby high-

Drawing Illustrates How Tone-Control

Assume that an operator at the Martins Creek terminal has closed the tone-start pushbutton. His action energizes the transmitter and in turn sends blocking signal F-1. The signal is received at Siegfried by the tone receiver, which energizes alarm element AL and RRH element of the carrier auxiliary relay. The AL contact picks up the SG relay. One normally open contact on the SG relay, in parallel with the tone-start pushbutton, closes to start transmission of blocking signal F2 back to Martins Creek. Reception of signal F2 at Martins Creek energizes the alarm relay which picks up the SG relay to seal in around the tone-start pushbutton. Channel supervision is now in operation.

Failure of any element of the duplex-tone channel, opening or short-circuiting of the pilot wire, will cause alarm (AL) elements at both stations to drop out and de-energize the SG auxiliary relay. The break contact of the relay will energize the JD timing relay, which after timing out, will pick up the MG auxiliary relay. At each station, the MG relay will sound the alarm bell and open the carrier trip and reclosing circuits. The timing relay provides a positive time delay to permit relay tripping. A quick-reset relay is used with a minimum setting within 2-15 sec.

This sequence would occur also whenever tone-stop elements, CSP or CSG, operate. For phase faults, the D and Z2 contacts of the distance relays close to pick up CSP. For ground faults, D_o and I_o contacts of the high-speed ground relay pick up CSG. When normally closed contacts of CSP or CSG open, they stop transmission of the blocking signal by the local tone transmitter. At the same time, CSP or CSG contacts remove a shunt from the TD element in the carrier auxiliary relay, which in turn closes and energizes the RRT trip coil. The RRT contacts cannot close to trip the local breaker until the RRH holding coil is de-energized.

For a fault in the end zones of the line, the tone-receiver circuit is de-energized, allowing the local breaker to trip through D, Z2, and RRT. If the fault is within the setting of Z1, Z1 contacts trip the breaker independently of the tone-trip circuits. For faults external to the line section, tripping is prevented as follows. Assume a fault occurs at Siegfried; then CSP or CSG at Martins Creek station will open and remove the shunt from the TD element. This in turn closes and energizes the RRT coil and stops transmission of tone signal F1. At Siegfried,

voltage fault, do not permit over-tripping of the line. Such a possibility may be limited by setting the phase and ground relays to cover the line adequately under all conditions, while otherwise confining their sensitivity as much as possible. Yet a nearby fault might cause failure of the telephone-circuit protective gaps or of other equipment. This danger can be minimized by careful planning of telephone circuits and terminal installations. High-speed reclosing further safeguards against over-tripping.

Three-Zone Relays Used

In the Martins Creek-Siegfried line, three-zone impedance distance phase relays are used, the line being not long enough for distance phase relays operating on a modified impedance. Potential-polarized, high-speed, directional, overcurrent carrier ground relays are used at Martins Creek, and current-polarized relays of the same type at Siegfried. Non-directional, overcurrent, ground-backup is applicable at both terminals. A type of carrier auxiliary relay was chosen which provides for future out-of-step detection to block tripping of second and third zones.

The dc trip circuit control for the tone-control scheme is shown in Fig 2. This control is very similar to power-line carrier, except that the MG contacts prevent tripping on loss-of-blocking tone after a short time delay. Tone-controlled contacts, RRP and RRG, supervise tripping in the conventional manner. As in the case of carrier-controlled relays, the first zone of the distance relay is independent of carrier and time-delay tripping. But the second and third timed zones are not under control of the tones so that backup is retained at all times.

The tone-control circuit is illustrated in Fig 3. It is similar also to conventional carrier, with the exception of the tone control and supervisory function. Accompanying Fig 3 is a discussion of operation of the circuit. Tones normally are started before the 220-kv line is energized, although this is not necessary. The dotted connection in Fig 3, which provides for automatic tone starting, is used at both line terminals. When tones are lost as a result of an open or short-circuited pilot wire, tone-controlled tripping is blocked automatically at both terminals after a short preset time delay.

Stop Blocking for Testing

Certain other troubles, such as, loss of one transmitter, result in the blocking of tripping at the opposite end, as no signal is received. The transmitter at the opposite end would be stopped for a short time and then re-started automatically. As this signal is received at the first end, tripping is not blocked there. An alarm is obtained only at one end for this type of trouble. Examination of Fig 3 shows that a through fault in either direction cannot cause over-tripping. By operating No. 2 test pushbutton, the blocking chain may be stopped to permit testing the channel.

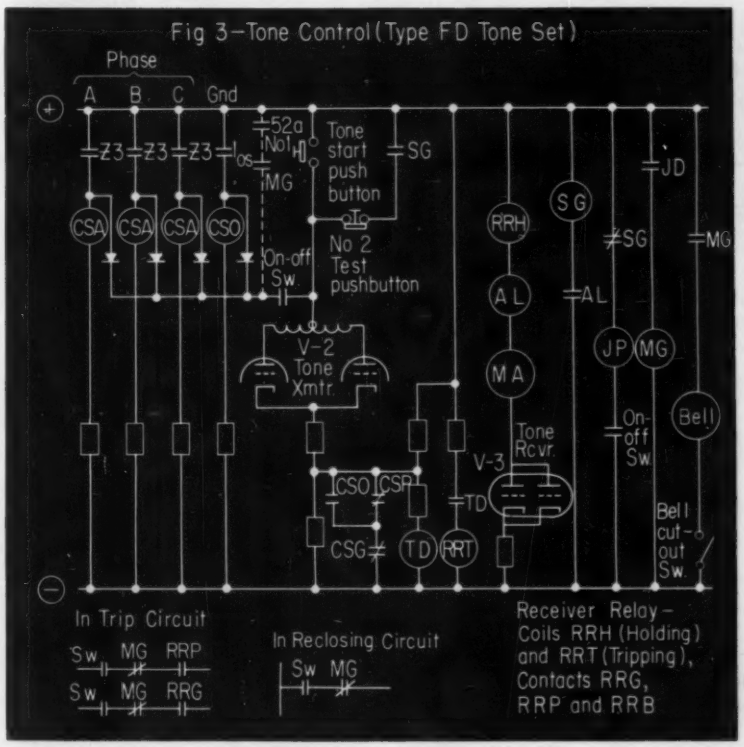
Audio-tone transmitter at Martins Creek operates at 765 cycles; the Siegfried transmitter at 1,275 cycles. Corresponding receivers are in-

Circuit Operates▸

the tone receiver de-energizes AL and RRH at the terminal and the SG relay drops out.

Normally this action would stop transmission of signal F2 at Siegfried. However, Z3 element of the phase relays or I_{os} element of the ground relay operates on the external fault and will retain transmission of the blocking signal F2 from Siegfried to Martins Creek. If signal F2 were not received at Martins Creek, holding coil RRH would be de-energized, allowing the RRT contacts to close and trip, since D and Z2 contacts of the phase relays are closed. Because blocking signal F2 from Siegfried to Martins Creek is being transmitted, the Siegfried line does not trip because RRH is energized and prevents RRT from closing.

After normal clearing of a fault, tone channels are de-energized. Supervision is re-established automatically by using a normally open contact of the MG auxiliary relay (dotted line in Fig 3) in series with a 52a contact of the breaker. When the transmission line is energized, the 52a contact closes and starts tone-signal transmission through the MG contact, which now is closed. After the circuit is set up, the MG contact in series with 52a opens, removing this tone-transmitter pickup source.



stalled at opposite ends. Tones are dc operated from the station battery, and frequency is determined by a tuned filter. Narrow-band tones were chosen, as they are somewhat less susceptible to external interference. A minimum of 2 ma is required to block tripping. If signal strength drops below 3 ma, the alarm relay does drop out, but block trips after a short delay and gives an alarm. Tone units are mounted on standard 19-in. racks in cabinets.

Tone-controlled relaying has been connected for tripping since October, 1955. There have been no faults on the line nor any close-by through faults.

Extend Tube Life

Tone transmission was lost twice, once due to opening of the ballast-tube filament circuit, and again for maintenance by the telephone company. No incorrect relay performance resulted. A dropping resistor was inserted in series with the ballast tube to extend its life. Because of difficulty in locating the trouble upon failure of the ballast tube, a filament-failure alarm unit was added. Because of the second outage, the telephone company is better informed about the circuit's special character.

In one other instance, plate current in a receiver fell below normal and was detected during a periodic reading. One receiver tube needed replacement. But the plate current had not fallen below a satisfactory operating value, and high-speed relaying remained in service.

The Martins Creek-Siegfried 220-kv line is the principal outlet for Unit No. 2 at Martins Creek Station. There are also three 66-kv lines connecting the station with the PP&L system, as shown in Fig 4. Should the 220-kv line be lost permanently when both generators are at or near full capability, thermal limitations of the 75-Mva transformer and the 66-kv outlet would be exceeded. If any of seven critical 66-kv lines are also out of service, the thermal limitation is even more severe.

Generator loading must be reduced promptly to the thermal limitations of the 66-kv outlet and the 75-Mva transformer ratings. When all seven critical 66-kv lines are in service, there is sufficient time to allow manual reduction of loading. Thermal rating of the lines is the determining factor. While the lines will carry the maximum load for 9 min, the operators are instructed to start load reduction immediately and complete the reduction in 9 min.

If one of the seven critical lines is out, the time limit is considered too short to depend upon manual reduction of loading. Automatic control will trip the No. 2 generator upon permanent loss of the 220-kv line if one 66-kv line is open. Tripping is also fast enough to prevent loss of stability that would result with one Martins Creek-Nazareth 66-kv line open.

A manual switch is used to place automatic control in service upon instruction from the system operator when a critical 66-kv line is out. Control is so arranged that when the 220-kv line trips, recloses, and trips again, generator No. 2 is tripped also. The generator is not tripped when the line trips once and recloses successfully.

Anything that takes tone-controlled relay tripping out of service blocks the high-speed reclosing. The generator is tripped coincident with the first trip-out of the line if the automatic control scheme is in service. Permanent faults on the 220-kv line are quite rare, and the automatic control tripping scheme is in service only when one critical 66-kv line is out and both generators are heavily loaded. Thus, it is expected that automatic trip-out of Unit No. 2 from this cause will be very rare.

Reduce Load Promptly

When the automatic tripping scheme is not in service, the operator must act promptly to reduce loading upon loss of the 220 kv-line. An alarm is operated by an overcurrent relay with very sensitive pick-up and drop-out settings for detecting loss of load. Even were the line terminal inadvertently opened at Siegfried, the Martins Creek operator would be immediately notified. This loss-of-load relay trips generator No. 2 after a few seconds delay when automatic tripping is in service.

The loss-of-load alarm on the 220-kv line is interlocked through a contact on the total-generation recorder. For load below safe limits, the alarm and tripping relay do not operate. Stability studies show that severe stable swings result with one critical 66-kv lines open. Even with No. 2 generator tripped, some swings operate the second-zone relay elements on 66-kv lines at Martins Creek and Nazareth. Out-of-step blocking relays prevent this separation. The instantaneous first-zone elements are not blocked.

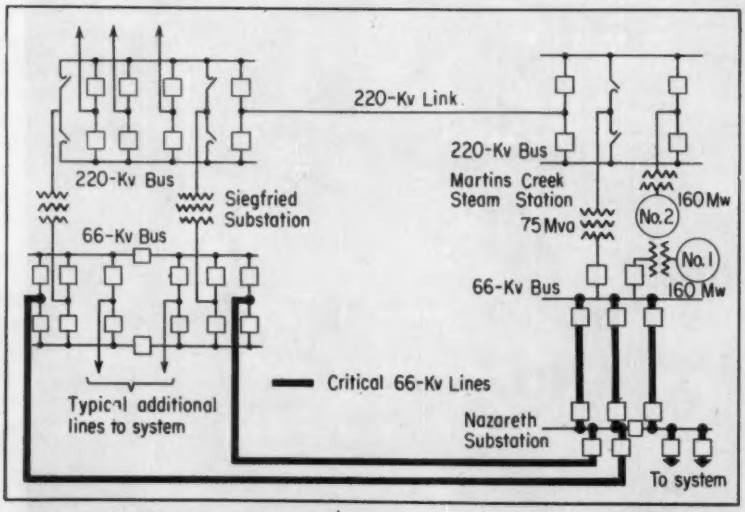


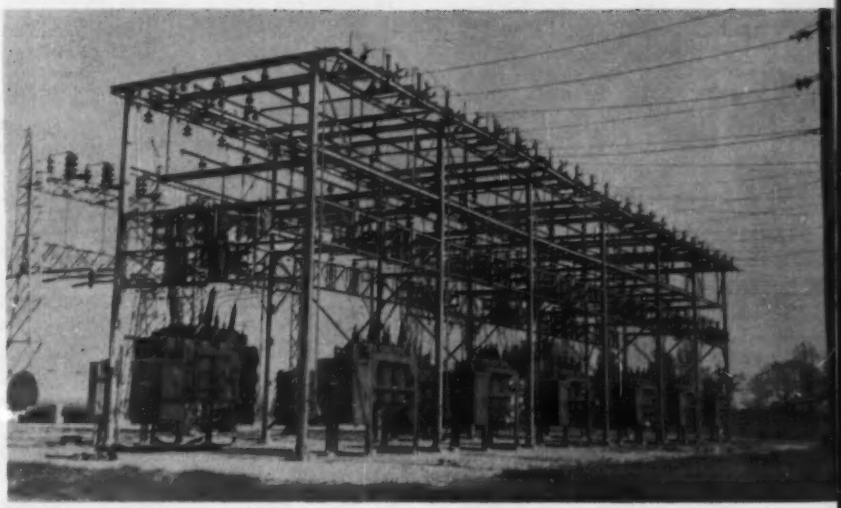
FIG 4—CRITICAL 66-KV LINES transfer power over system if 220-kv link is lost. Automatic tripping control of Unit No. 2 obviates thermal overloading

Structures Cut Substation Cost

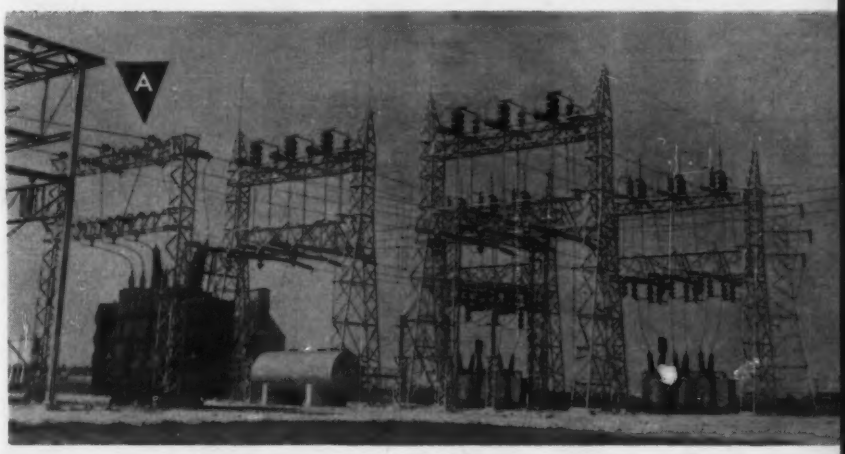
JOHN D. SHAW, Transmission Engineer, Virginia Electric & Power Co, Richmond, Va.

Basic unit-type structures, developed for 132, 110, and 66-kv substations by Virginia Electric & Power Co, save engineering and drafting time, allow faster ordering of steel, and are flexible enough to make expansion costs minimal.

In accommodating the basic plan to a particular site, transparent prints are made of the original drawings and modified for local requirements. Structures have a wire tension of 2,000 lb under NESC heavy-loading conditions. The high-voltage buses are strain buses, usually all-aluminum conductor. Cross buses are 500 MCM; main buses 1,000 MCM. A long bus, involving a ground clearance problem, is supported at its center by a light structure with pedestal insulators. Foundations can be standardized except for dimensional variations to meet soil conditions. Dead-end structures are assembled on the ground and lifted in place by a crane; larger structures are erected piece by piece.

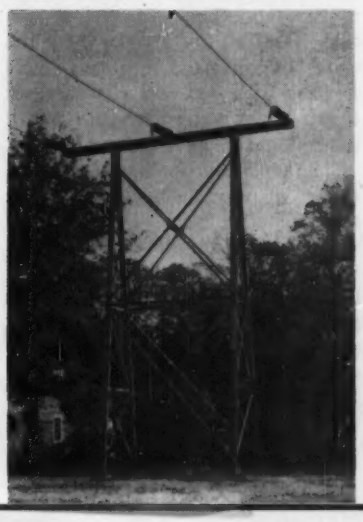


SWITCHING STRUCTURE for 13.2, 22, and 34.5 kv has tubular bus, sectionalizing breakers, and six breaker bays. It measures 29 ft 6 in. high, and 18 ft deep

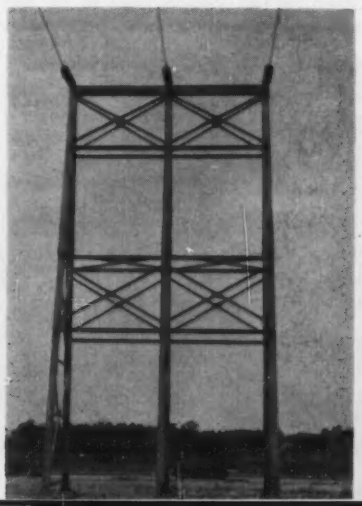


FIVE BASIC STRUCTURES are combined in this typical 110-13.2-kv substation. Tower (A) is designed as a standard transformer structure. It measures 29 by 24 ft, and has 2-ft wide columns

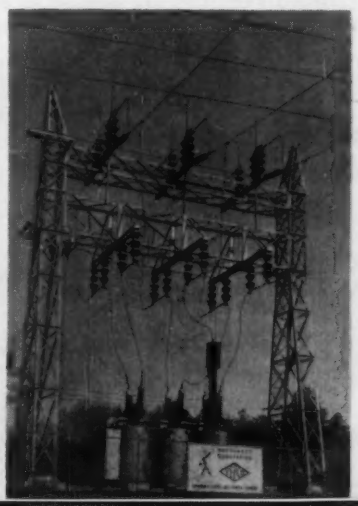
LIGHT DEADEND terminates main and transfer buses. It's 33 ft by 10 ft



HEAVY DEADEND provides for longer spans. It's 30 ft high and 10 ft deep



110-KV STRUCTURE mounts disconnect switches either underhung or vertically



Once-Thru Boiler Used for Subcritical

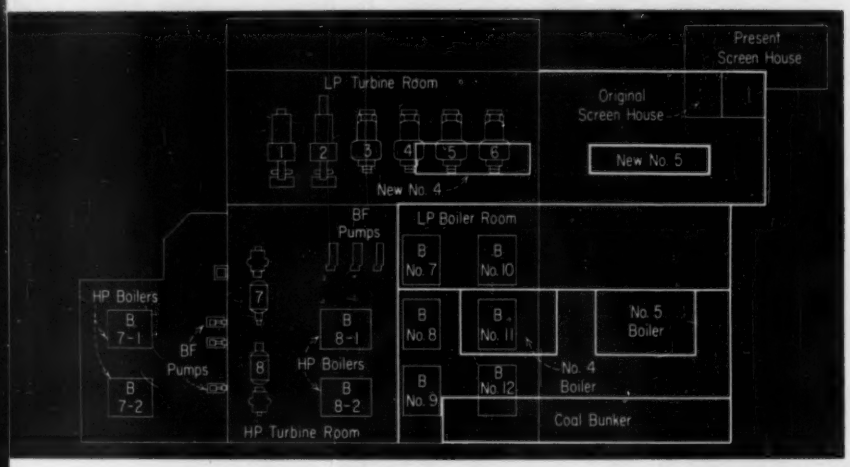
Design appears to offer the possibility of lower capital expenditures for 2,400-psig, 130-Mw generating units

HOWARD E. GISMOND, Chief Mechanical Engineer, The Dayton Power & Light Co, Dayton, Ohio

Pioneering among utility companies is not confined to the largest systems. A good case in point is The Dayton Power & Light Co which placed in operation the first hydrogen-cooled generator at the Frank M. Tait station in 1937 and its adoption of semi-outdoor construction for the O. H. Hutchings station constructed shortly after World War II. Not only was the Hutchings station one of the first of its type built in a latitude as far north as Dayton, but its third unit was one of the early single boiler-turbine-generator units operating on the reheat cycle. As a system The Dayton Power & Light Co has compared very favorably with other electric power generating companies on the basis of thermal efficiency and net plant heat rate.

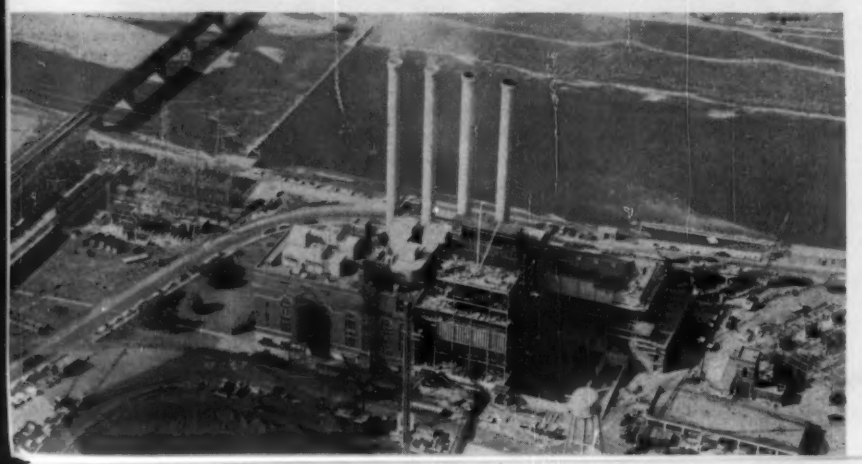
This same spirit of pioneering is characterized in the company's plans to purchase the first once-through boiler to be used at conventional pressures by any electric utility in the United States.

This once-through type boiler will be the outstanding feature of the modernization and expansion of the Frank M. Tait station.



FIRST of new 130-Mw units goes in existing turbine room at right angles to the other turbines. Its steam generator replaces the old low-pressure equipment

EXISTING FACILITIES are retained in modernizing Tait Station, even to the turbine-room crane. But the water intake and tunnels require some modification



The decision to use the once-through type boiler for subcritical pressure operation was based on these considerations: Valuable experience would be obtained with a type of boiler suited to the supercritical pressures of the future; the design appeared to offer the possibility of lower capital costs; it has attractive features from the standpoint of higher availability. Accordingly, a 2,400-psig, 1,050/1,000F unit was purchased in 1955. And a second unit of the same type was ordered in 1956.

Both units will have a rating of 130-Mw, more than double that of the largest existing turbine generator on the system.

In proposing the current expansion of generating capacity, the company gave serious consideration to: **1.** Replacement of existing equipment at Tait Station; and, **2.** Construction of a station on a new site. Favorable factors which influenced the decision to construct a new unit at Tait included:

1. Proximity to load center.

2. Available power distribution lines.

3. Desirability of replacing existing equipment, some of which had been installed as early as 1922.

4. The high heat rate and maintenance costs of older units.

5. Possible use of existing facilities in the modernization expansion.

Water Separator Needed

The water and steam paths for the once-through type steam generator differ from those in the conventional unit. As indicated on p 53, the feedwater entering the boiler flows through the economizer and on to the monotube evaporative section. Here all but about 4% of the water is converted to steam. This mixture of steam and water passes to the boiler water separator where the residual water is removed.

The separator establishes the condition of the steam entering the superheater at the dry and saturated state. This, is in effect the first step in steam temperature control, makes it possible to regulate the final temperature more closely. The separator also permits the installation of a continuous blowdown as a means

Operation

of assisting in the control of feedwater quality. The water eliminated in the separator carries, in concentrated form, a portion of the impurities in the feedwater. Normal practice provides for a 1% blowdown and the return of 3% to the top feedwater heater.

Quantity of blowdown can be regulated to maintain feedwater purity. If deposits form in the evaporating circuits, the tubes can be washed during normal operation by temporarily increasing the feedwater flow above normal requirements. The excess water, carrying the dissolved solids, is removed at the water separator.

Evaporator Supplies Makeup

Steam from the boiler water separator passes through the primary, intermediate, and finishing superheater sections. It then goes to the high pressure turbine, back to the reheater section of the steam generator, and on through intermediate-pressure and the low-pressure sections of the turbine. Passing through the condenser, the feedwater returns to the economizer section through the usual low and high-pressure heaters, deaerator, and boiler feed pump. Makeup water for the unit will be supplied by an evaporator.

The Combustion Engineering Monotube steam generators at Tait combine features of American and European central station practice. General arrangement of heating surfaces is not essentially different from those in the many controlled-circulation boilers now in service. Corner firing using tilting tangential burners will be employed.

Several factors led to the selection of this once-through type boiler for generating steam in the conventional range below the critical pressure. For one thing, installation of this type of unit will provide experience in anticipation of use of more advanced steam conditions.

Other factors contributing to the selection include the prospect of less material by weight than in a conventional natural-circulation boiler and the assurance of positive circulation advantageous at high operating pressure.

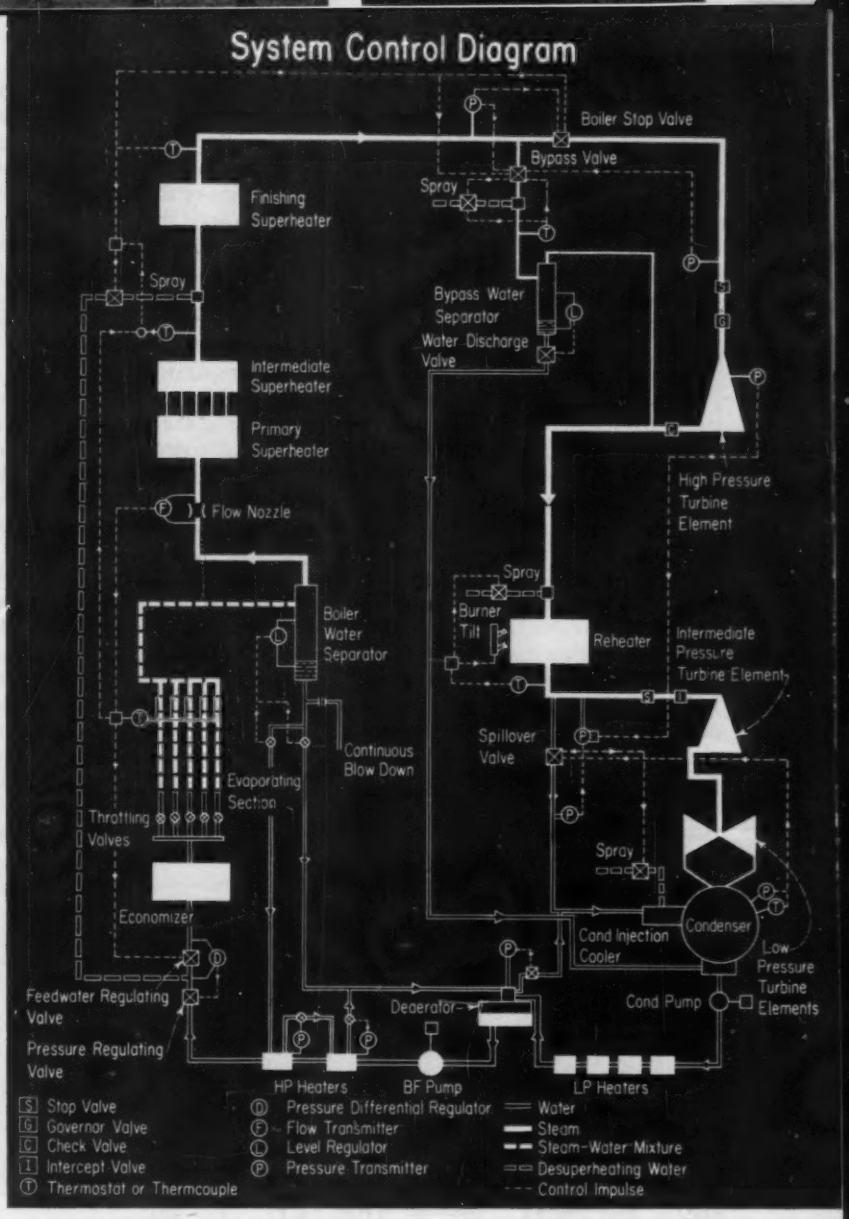
The steam generator for the Tait station is designed to deliver 940,000 lb of steam per hr to the turbine throttle at 2,400 psig, 1,050F with reheat to 1,000F. The following limits have been established for feedwater:

Total solids
0.5 ppm max (0.25 ppm recommended)
pH . . . . . 8.8 to 9.2
Hydrazine . . . . . slight excess
Dissolved oxygen . . 0.007 ppm

The 130-Mw turbine generator will be a tandem-compound, double-flow, 3,600-rpm machine. The generator is rated at 173 Mva at 30-psig hydrogen pressure.

An automatic oil hydraulic control system made in Europe by Sulzer Bros will control feedwater flow, regulate primary steam temperature, and operate the turbine bypass system. This latter system provides desired characteristics for starting from a cold condition, for a hot quick restart, and protection of the unit in abnormal operating situations.

Feedwater flow is regulated by a three-element control. An anticipating impulse from steam flow is provided by the pressure differential across a flow nozzle in the steam piping beyond the water separator. The feedwater valve is designed and operated in such a manner that



feedwater flow is a direct function of valve position. This metering action provides the second element. The final impulse comes from the multiple thermostat correcting the feedwater flow to maintain a slight superheat at the outlet of a control tube. This is adjusted to correspond to 4% moisture in the steam entering the boiler water separator.

Condenser Protected

In the turbine by-pass system steam by-passes the turbine through the automatic by-pass valve and discharges into the by-pass water separator. From the separator, dry steam flows through the reheater and the spillover valve and into the condenser through an injection cooler. By-pass steam is desuperheated as it enters the by-pass system to the normal temperature entering the reheater. It is desuperheated again in the injection cooler to protect the condenser against high temperature.

Any water which enters the by-pass system, as during startup, is removed at the by-pass water separator and discharged to the condenser hotwell. The steam stop valve and by-pass valve function automatically under pressure and temperature controls to permit flow to the turbine or through the by-pass system as conditions dictate.

The combustion control system, as developed by Leeds & Northrup, integrates the operation of the boiler and turbine as a unit. Unlike a conventional combustion control system, it regulates the turbine governor in addition to the inputs of fuel and air to the boiler. Two basic methods of control are being installed at Tait. Either one may be selected by the operator as dictated by the ultimate field operation of the unit.

1. With the "Direct Energy Balance" method, the input of fuel and air supplies to the boiler are directly regulated from the unbalance between required output and the actual generator output. The turbine governor is controlled to maintain a uniform steam pressure. With this arrangement the boiler input is directly controlled to give the desired generator output, and the turbine keeps in step with the boiler output.

2. The "conventional" method regulates the turbine governor to give the required generator output. And the boiler input is basically controlled to maintain steam pressure. Combustion rate anticipation is obtained from the generator output, plus the regulation applied to the governor motor. With this arrangement the boiler follows the turbine demand.

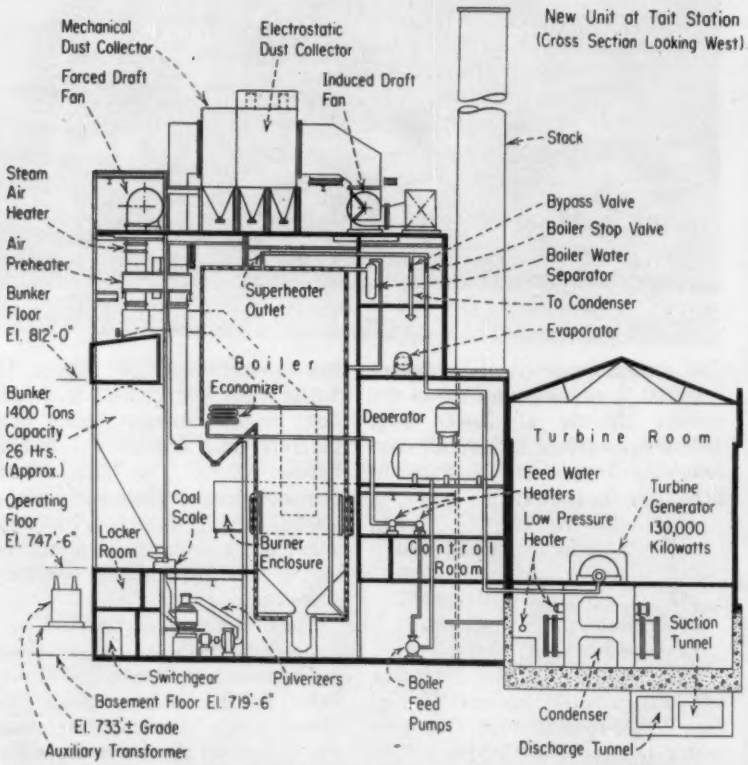
Additional features of the control system include a "boiler turbine governor" component, which provides a means of changing boiler-turbine output in an orderly manner and of keeping the output within the capabilities of the boiler and turbine equipment. Automatic compensation of the fuel-air ratio from the oxygen content of the flue gases is used to insure optimum combustion efficiency. The oxygen sampling equipment provides an average sample from four points across the flue gas duct.

Existing Stack To Be Used

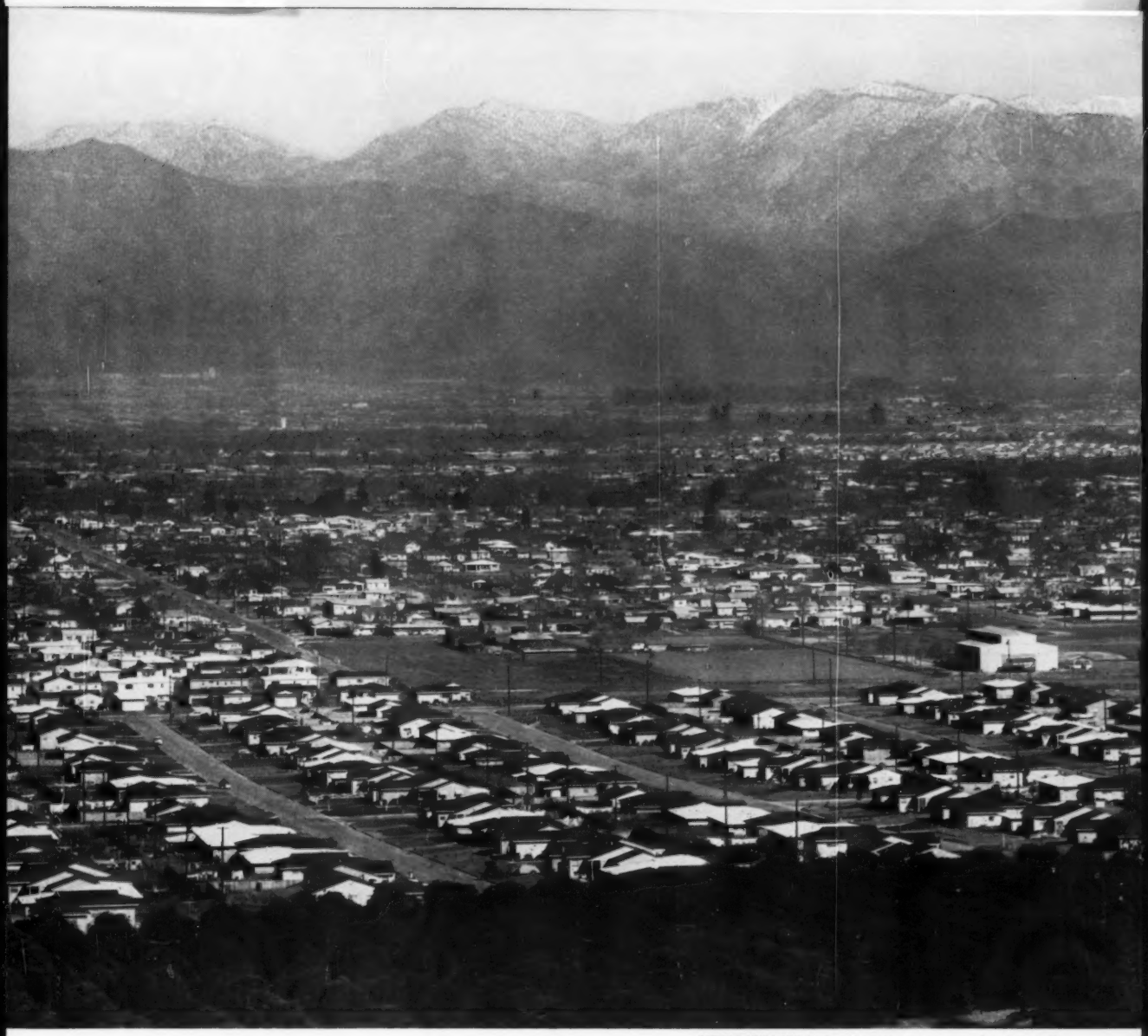
In the original station constructed in 1918 three boilers were operated with natural draft on a single stack. This same stack will be used in conjunction with forced-draft and induced-draft fans for the new units. Circulating water intakes and tunnels of the existing stations will be used for the new units, with some modifications of the tunnels and screen house. The original turbine-room crane will be used for the new turbine generators. The first new unit will be installed in the same turbine room, but with its axis at right angles to the original turbine generator.

A completely new coal handling system will serve both the existing and the new units. The coal handling system will include an 800-ton per hr conveyor system, a car dumper, and a new bunker having a 26-hr capacity at full load. A sampling system for coal analysis and individual coal scales for each mill will be provided.

An interesting aspect of the selection of the existing site is that the quantity of circulating water required for the three retired units, which had a combined output of 65 Mw, was 124,000 gpm. Each of the proposed 130-Mw reheat units will require 80,000 gpm.



BOILER WATER SEPARATOR is placed near top of new once-through steam generator. New ID and FD fans enable the existing stack to serve new boilers



NEW HOUSING in Los Angeles area spurs load growth

DISTRIBUTION TRENDS REPORT:

Keeping ahead of load growth makes Southern California Edison one of fastest-growing utilities

Now serving the electric power needs of some 4,200,000 people in ten southern and central California counties, Southern California Edison is one of the fastest-growing investor-owned electric utilities in the nation. In new meters added, it has topped all others for five of the last six years. Over the last decade, it has more than doubled its meters to a present total of almost 1,500,000. In fact, during the five years ending December 1956, its new meters were equivalent to the number required to serve a city of 800,000 population.

Initial cause of this growth has been the tremendous population influx into SCE's service area. But this in turn has touched off an even greater growth in commercial and light industrial loads. The distribution challenge facing SCE, therefore, has been to keep simultaneously ahead of a booming growth in three areas of load—residential, commercial and industrial.

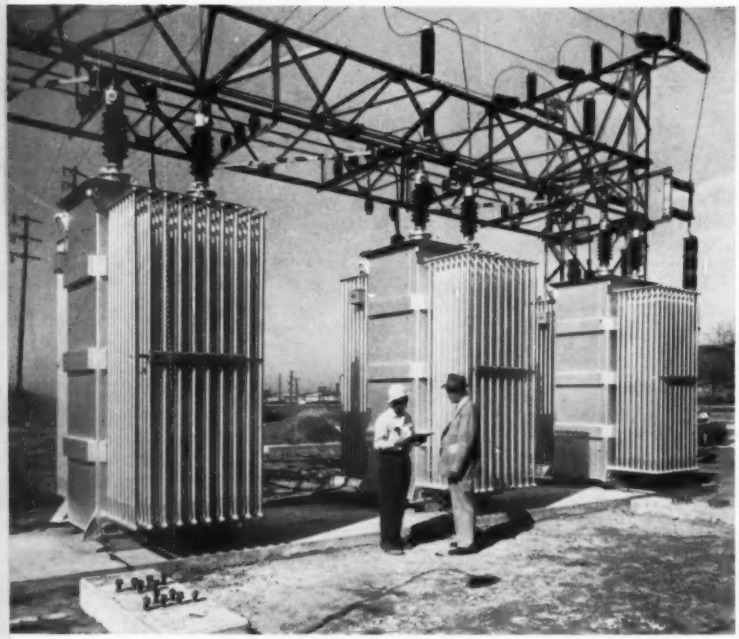
MORE POWER TO AMERICA

GENERAL ELECTRIC

Here's how General Electric helped SCE meet this challenge

DISTRIBUTION TRENDS REPORT:

Co-ordinated headquarters planning, based on "grass-roots" district recommendations, helps Southern California Edison prepare for mushrooming growth in all load areas



FASTER SYSTEM EXPANSION for SCE, through simplified purchasing and shorter deliveries, is permitted by repetitive-manufacture of G-E medium transformers. These in recently expanded Puente Substation, being discussed by G. Canfield (left) and W. I. Hartshorn, Foreman and Supervisor of SCE's Construction Dept., are three single-phase oil-insulated air-cooled units, rated 66 kv, 3333 kva.

The phenomenal load growth in Southern California Edison's service area is based on a variety of factors. Besides higher domestic consumption, they include increased industrial productivity, more shopping centers, offices, schools and hospitals, and more widespread use of improved lighting, air conditioning and electronic devices. The effect of these factors was reflected in 1956 kwhr sales when commercial sales were up 18.2%, domestic sales 13.5%, and industrial sales 11.1% over the previous year. To bring its long-range distribution planning into focus every year, SCE must know what and where the greatest anticipated growth will be, and for this it relies on "grass-roots" information from its 29 field districts.

HOW THE PLANNING WORKS—Each of SCE's districts has a distribution superintendent responsible for operation and planning, in addition to a commercial manager. The distribution superintendent continually makes long-range growth plans based on load studies and land developments. Once a year these plans are formalized into specific recommendations for new expenditures and installations keyed to growth areas. In this he works closely with the

SUSTAINED ACCURACY of G-E single-stator watthour meters is made possible by magnetic suspension feature which eliminates bearing wear. M. G. Spaller, Asst. District Supt. for SCE, observes installation by J. L. Mertel in new home.

REDUCED SYSTEM LOSSES and higher kilowatt loadings on feeders are obtained by SCE with this 225-kvar bank of open-rack pole-top G-E fixed capacitors. They also help maintain improved voltage levels by relieving generating and transmission facilities of the need for supplying the basic kvar load.

PLANNING CONFERENCE on distribution system expansion brings together (left to right) G. A. Davis, SCE Senior Planning Engineer; P. M. McCann, SCE Supt. of Distribution; W. T. Scott, G-E Sales Engineer; R. B. Kimball, G-E Electric Utilities Application Engr.; and E. H. Clark, SCE Asst. Chief Distr. Engr.

district commercial manager, who contributes information about the business and manufacturing expansion planned for the area within the next year.

MASTER PLAN PREPARED AND IMPLEMENTED—District recommendations are funneled to headquarters distribution engineering, where they are co-ordinated with the Company's overall generation and expansion plans. The final result is an integrated, master plan for expansion of the distribution system in the coming year. In implementing these plans, Southern California Edison has made extensive use of General Electric engineering assistance and equipment.

Working closely with SCE substation and protection engineers, General Electric application engineers provided engineering assistance in applying protective relaying equipment, regulators, and circuit breakers. In addition, General Electric engineers designed and applied a special ceramic bushing for capacitors to resist the area's severe atmospheric conditions.

When you specify General Electric, you take advantage of the latest advances in apparatus design, construction, application and the assistance of complete engineering services. To help utilities keep service running smoothly, highly trained General Electric service engineers plus a network of Service Shops stand ready to meet any and all maintenance and repair needs—day and night.

For full information on distribution equipment and Distribution System Services, contact your nearby General Electric Apparatus Sales Office, General Electric Company, Schenectady 5, N.Y.

LONGER SERVICE LIFE for G-E distribution transformers is aided by such exclusive features as one-piece stainless-steel clamping bands that result from continuing product development. Here, SCE linemen hook up a 15-kva pole-type G-E distribution transformer for residential service in a nearly completed housing development.

ADDED DEPENDABILITY of G-E distribution transformers stems in part from production-line impulse testing, most sensitive method known. These single-phase 100-kva G-E units are being connected to serve a large super-market in SCE service area.

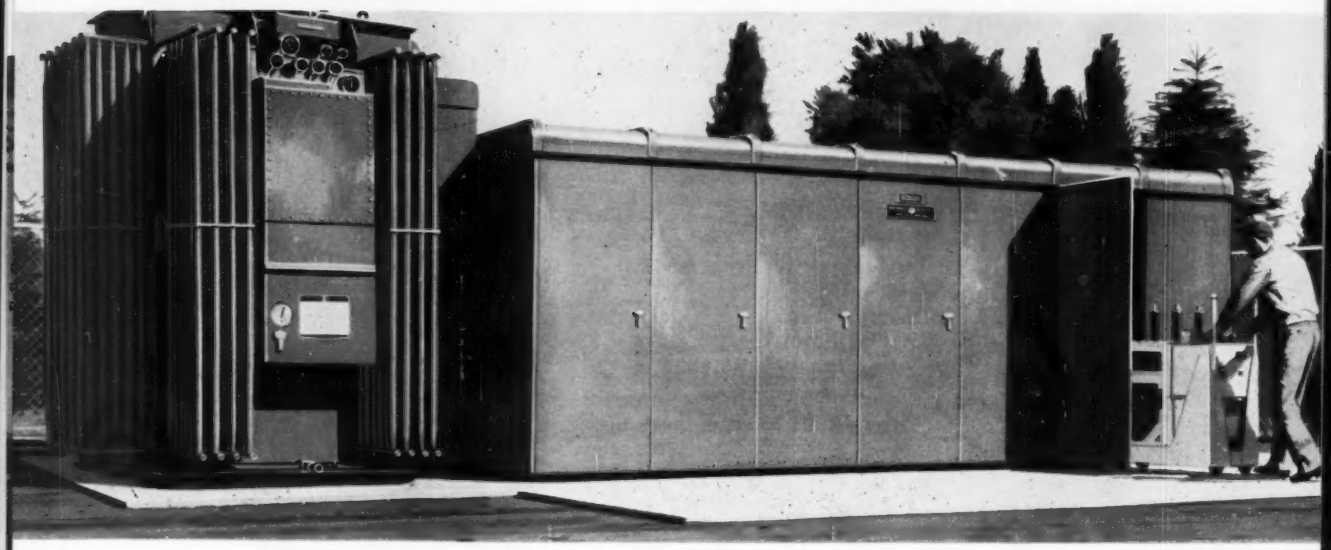
MORE POWER TO AMERICA

GENERAL ELECTRIC

Here's why it pays to see General Electric about your distribution problems

DISTRIBUTION TRENDS REPORT:

Southern California Edison is one of the major utilities using General Electric factory-built unit substations



HERE'S WHY:

Among the nation's major electric utilities, Southern California Edison is one of more than 100 that are saving time and money through reliance on General Electric factory-built unit substations.

These complete, ready-to-install substations are fully co-ordinated for dependable performance. With only one specification—one invoice—required, your purchasing is enormously simplified. There are no extras or accessories to buy, which makes the substation's low installed cost a realistic, predictable one. And because they are pre-engineered by General Electric, your engineers are relieved of many of the time-consuming technical details and made available for more productive work.

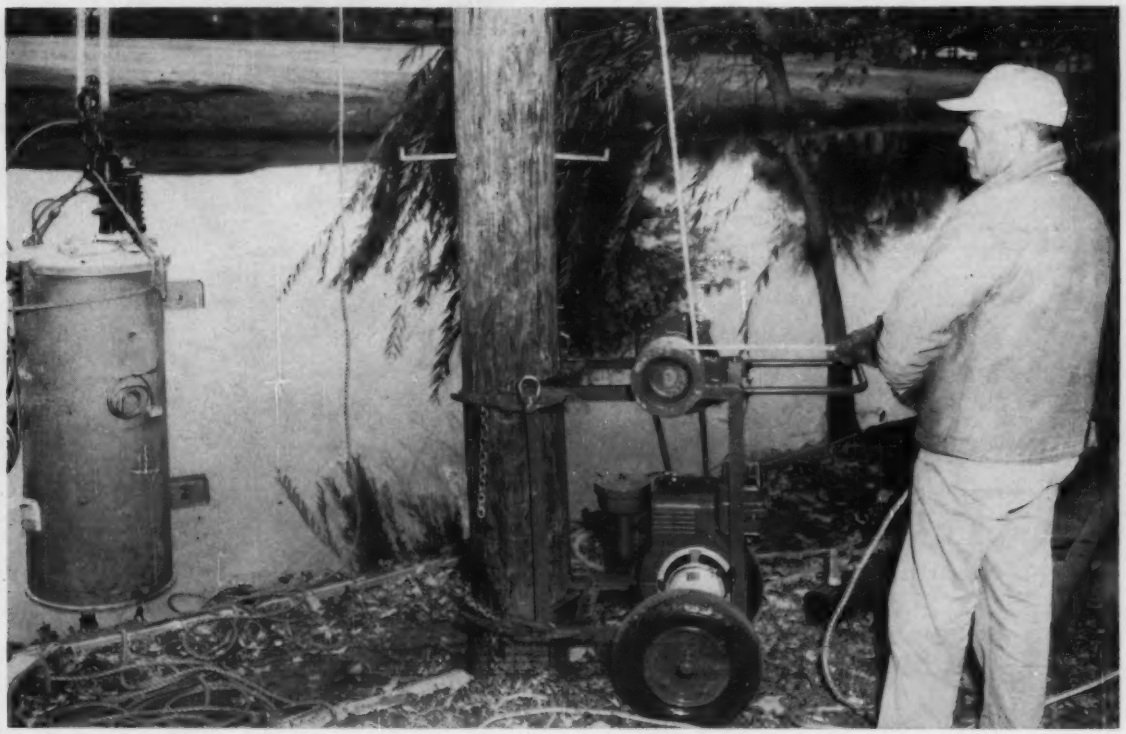
When you specify General Electric, you get the benefit of General Electric Distribution System Services which include extensive product development facilities—headquarters system planners—district application engineers and product specialists—equipment installation and field service engineering.

These services offer assurance of maximum operating continuity, on-the-spot application help, equipment efficiencies, valuable help in system design and techniques. Get the full story from your General Electric Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y. 303-5

LIVE BETTER ELECTRICALLY

MORE POWER TO AMERICA

GENERAL ELECTRIC



Power Rig Raises Transformers Easily

LESLIE BUFORD, Dallas Power & Light Co, Dallas, Texas

Raising transformers where trucks can approach reasonably close to the pole has been greatly simplified by power equipment. It has not been possible to use power equipment of the truck, however, where poles were on easements or other places inaccessible to trucks.

This problem has been solved by mounting the necessary power equipment on a light-weight, rubber-tired rig that can be rolled over lawns and taken to almost anywhere a distribution-type transformer can be transported.

Power is supplied by a gasoline engine through a power takeoff. The rig is held firmly in place by chains that go around the pole. The equipment can raise transformers up to 37½, 50 or even 75 kva. It saves time and muscle-power.

GENERATION—Maintenance

Dry Cleaning Saves Control-Air Filters

JAMES HALEY, Results Dept, Kyger Creek Station, Ohio Valley Electric Corp, Gallipolis, Ohio.

Control-air filters are necessary ahead of the pilot valves to remove oil, water, and dust, but frequent replacement of filters can become costly. The 30 annual replacements of filters for Kyger Creek Station's five control-air stations was costing an estimated $1,200.

Means were sought to reduce this replacement expense. A cleaning establishment was found which cleaned the filters for $2 apiece which represents a saving of $38 per filter or $1,140 per year. This is a net saving even though spare filters must be available for replacement of filters, as spares were available prior to this procedure.

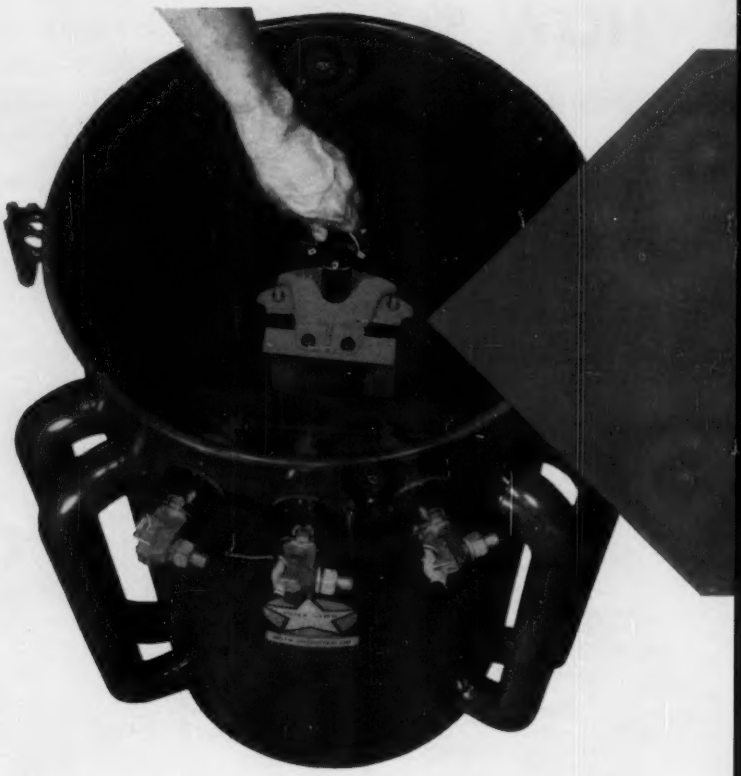
The effect of dry cleaning and repeated use on the filters' useful life has not yet been determined. But indications are that more than two cleanings can be obtained. Thus the annual savings may be extended.

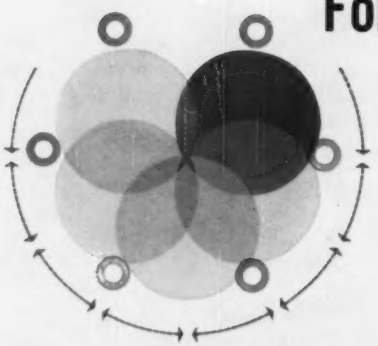
(*More How To on page* 62)

Pennsylvania

Introduces:

A NEW MORE RUGGED POLE STAR





Orange circles represent the five tap positions in which the movable, double-disc contact can be placed. A coil spring holds the discs firmly in place against adjacent stationary studs, represented by the smaller circles. The coil spring also results in snap-action movement from one position to the next when the tap changer operating handle is turned.

For: Greater Dielectric Strength

Higher Impact Strength

Lower Power Factor

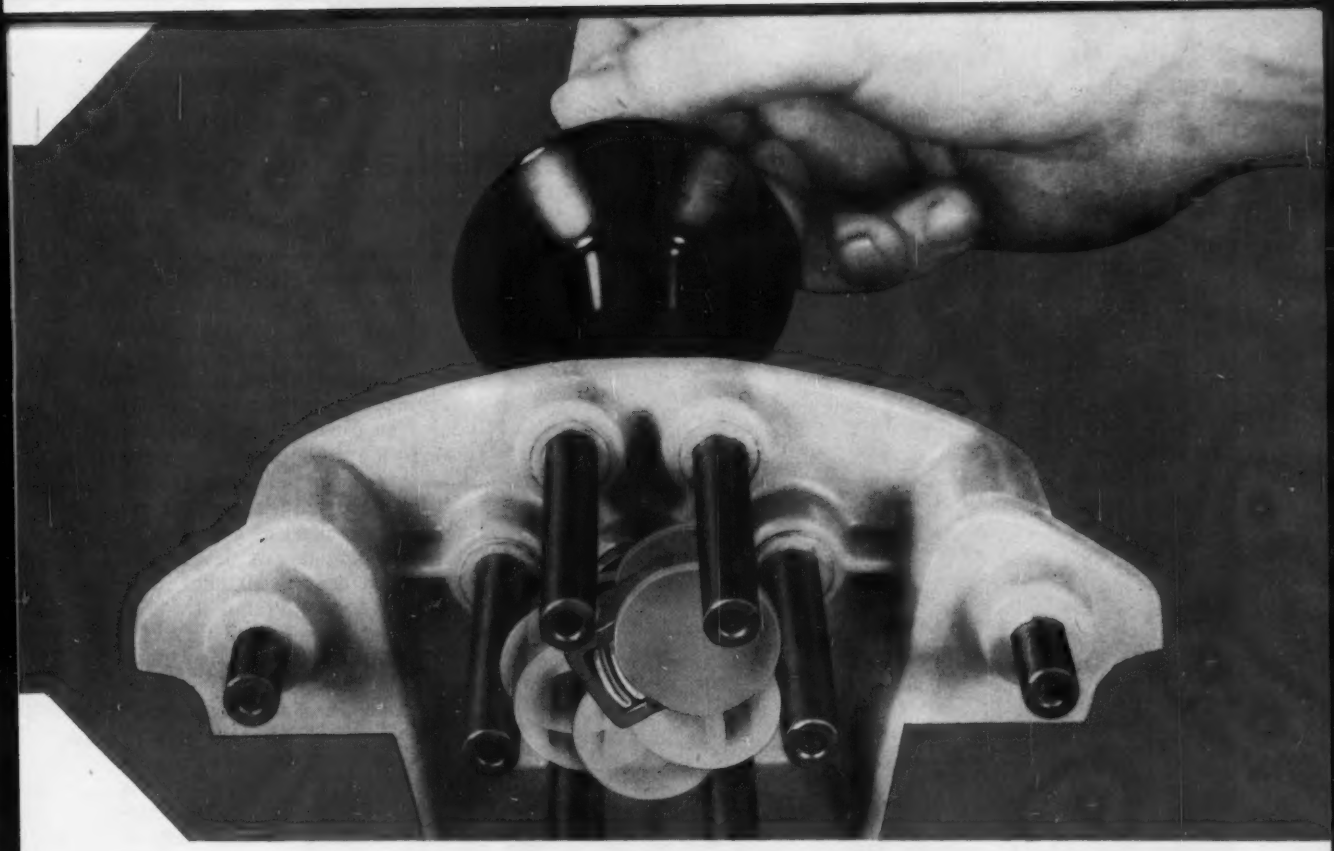
Excellent High Temperature Stability

More Accurate Dimensional Stability

Longer Creepage Distances

Elimination of Sludge-Gathering Projections

PENNSYLVANIA DISTRIBUTION



TAP CHANGER

The new tap changer is designed for all Pole Star distribution transformers through 167 kva, 18 kv class and below. Months of meticulous testing and research conclusively proved the superiority of glass-fibre-filled alkyd resin for this application. By providing far greater impact strength than the porcelain previously used for the tap changer body, alkyd resin imparts a new ruggedness to the Pole Star tap changer.

The new tap changer also has outstanding electrical characteristics—greater dielectric strength, lower power factor, longer creepage distances—as well as an ability to withstand extreme and sudden temperature changes. Elimination of sludge-gathering projections alone (there are no nuts and bolts on the top surface) can lengthen service life in cases where moisture enters the tank when taps are changed.

The new tap changer is one of the many Pole Star "plus" features. Contact Pennsylvania Transformer Division, McGraw-Edison Company, Box 330, Canonsburg, Pa.

Design and Construction Features of New Pole Star Tap Changer

1. New tap changer body is made of glass-fibre-filled alkyd resin, in which modern materials research has combined the most highly desirable electrical and mechanical characteristics.

2. Stationary copper studs are molded into tap changer body. Resulting absence of nuts and bolts on top surface provides greater creepage distances . . . eliminates sludge-gathering areas.

3. Floating brass roller with double-contact discs is loaded by coil spring that snaps roller into exact tap position when operating handle is turned.

4. Crimping with pneumatic tools provides outstanding electrical and mechanical connection that neither age nor vibration will deteriorate.

5. Easy-to-read tap changer dial is located above oil level. Extra-large letters are white on solid black background.

TRANSFORMERS

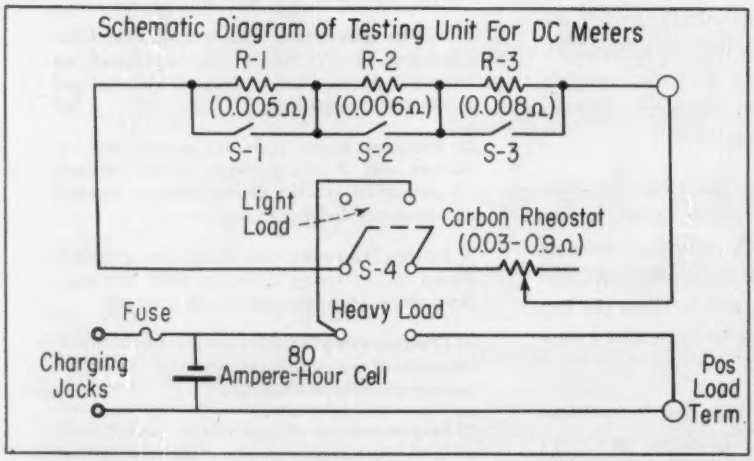
PENNSYLVANIA POLE STAR TRANSFORMERS

McGRAW EDISON

New Meter Testing Unit Weighs Less

F. R. KELLER, Supt, Meter Bureau, Consolidated Edison Co of N. Y., Inc, New York, N. Y.

PORTABLE DC METER TESTER is used for watthour meters rated more than 25 amp. Load equipment offers a reduction in weight and is housed in a box which is 7½ in. sq and 11 in. high. Current is supplied by a nickle-cadmium cell



CARBON RHEOSTAT provides fine control of current in the external circuit. It is connected in series for light loads and in parallel for heavy loads. Nickle-cadmium cell is discharged before being recharged to prevent overcharging

Reduction in weight is one advantage featured in the new loading equipment used by Con Edison for testing dc watthour meters rated more than 25 amp. The equipment also has improved load control and requires less battery maintenance.

The loading unit is designed to supply and control 50 amp maximum. With such a rating it will be able to test meters rated up to 75 amp. A larger unit capable of testing meters rated 300 amp is under development, and even larger units are contemplated. An ammeter, voltmeter, and timer complete the testing equipment. Current for testing is supplied by an 80-amp hr hermetically sealed nickle-cadmium cell. A double-pole, double-throw switch selects heavy-load or light-load controls.

For Heavy or Light Loads

With the load selector switch (S-4 in diagram) in the heavy-load position, eight coarse heavy-load control steps are provided by three resistors (each paralleled by a single-throw switch) in series with the external circuit. A carbon rheostat in parallel with the external circuit allows fine control. Decreasing the resistance decreases the current in the external circuit. With the switch in the light-load position the carbon rheostat, connected in series with the external circuit, controls light load.

The unit can be carried by hand between premises. It is used for a week before charging is necessary. Charging is accomplished over the weekend. To prevent overcharging a cell which may have had little use, the cells are totally discharged before charging. The testers can do this while they are returning the units from the field to the charging location. Throwing the load selector switch to the heavy-load position, opening switches S1, S2 and S3, and compressing the rheostat discharges the battery.

KYOVA
Celebrates
its first
Christmas

with
sincere
season's
greetings
for you!

"Oh Christmas Tree, Oh Christmas Tree, how lovely are thy branches . . . How tall and straight thy trunk. Of course, the trunk is straight, it's Kyova brand fiber conduit . . . and tall, too, because it's the long 10-foot length made by Kyova.

KYOVA
FIBER PIPE COMPANY
IRONTOWN, OHIO

When customers pay their bills . . .

amid this array of gleaming appliances . . .

Con Ed 'Captures' 'em with All-Electric Kitchen

Consolidated Edison Co is literally "capturing" an audience for its new all-electric kitchen.

Customers coming to pay bills at the utility's Westchester office in White Plains must do so across a counter located in a gleaming powder blue and chromium kitchen.

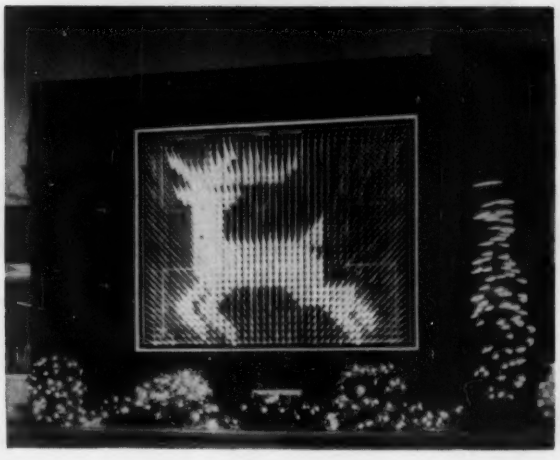
Dubbed the "Rocking Chair Kitchen of 1958," it is an outgrowth of the thinking of some 1,500 New York City apartment wives, expressed in a Con Ed survey called "So We Asked the Ladies" (EW, Feb. 4, 1957 p 16). It incorporates the latest electrical appliances plus the refinements for future additions.

Con Ed's idea is to give the apartment wife the same lease on modern electrical living her private-home counterpart now enjoys. Said L. A. Scofield, boss of the big utility's Westchester Division, "As the name implies, it has been planned to demonstrate that kitchen chores can now be done with ease and dispatch, and we hope that many of our friends will visit it during the next few months."

But "Rocking Chair" is not tailored exclusively for cliff dwellers. Scofield pointed out that "it contains numerous features and suggestions for families who live in private homes as well as those in apartments." Example: Area in the wall space for a picture window (this is actually an office store window in the Westchester set-up.)

Here's what the compact 9 by 11-ft kitchen contains: Wall-type oven; counter-top range; electric dish washer; garbage disposer unit; washer-dryer combination; a refrigerator-freezer combination; and exhaust fan. Lighting comes from a louvered ceiling, plus special fixtures for dining and counter work.

Nela Park Lights 24th Annual Outdoor Christmas Display



General Electric's Nela Park recently lighted the 24th edition of its annual outdoor lighting display.

The striking electric-light reindeer shown at left is only one of many displays on the Park's buildings, lawns, trees and shrubbery. Theme this year is "Joy to the World."

Other highlights include a 100-ft, man-made Yule Tree, on which more than 7,000 lamps sparkle to produce an animated effect; a nativity scene; a new pipe-sculptured "Wise Men" motif; and illuminated toys.

The Christmas display, which has become a seasonal highlight in Cleveland and the surrounding area, is expected to draw some 500,000 visitors.

The display also contains practical Christmas lighting "recipes" for home, office, and industry.

(*More Selling on page* 68)

Iowa Southern Utilities gets life-of-turbine guarantee against turbine oil worries

Utility installs NONPAREIL Turbine Oil in two units at Eddyville station

On September 20, 1953, two Westinghouse 20,000 kw. turbines were installed in Iowa Southern Utilities' Eddyville station. Two guarantee certificates, covering the two 1,200 gallon fills, were issued to the utility by Standard Oil. These certificates guarantee Iowa Southern Utilities that for the life of these turbines, the NONPAREIL Turbine Oil will never exceed an acidity level of 0.15 mg. KOH/g. The utility can depend upon the level being much lower—usually on the order of 0.03-0.05 mg. KOH/g.

The significant point to this story is that it is so routine. Iowa Southern Utilities has been installing NONPAREIL Turbine Oil in turbines since 1942. In the years since then, all turbines in the system have been converted to this oil. The oil is backed up with a life-of-turbine guarantee.

Having an oil with such a guarantee permits Iowa Southern management to direct its attention to the operation of its properties without worry about turbine oil performance. Additional facts about NONPAREIL Turbine Oil are available from your nearby Standard Oil industrial lubrication specialist in any of 15 Midwest and Rocky Mountain states. Call him, or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

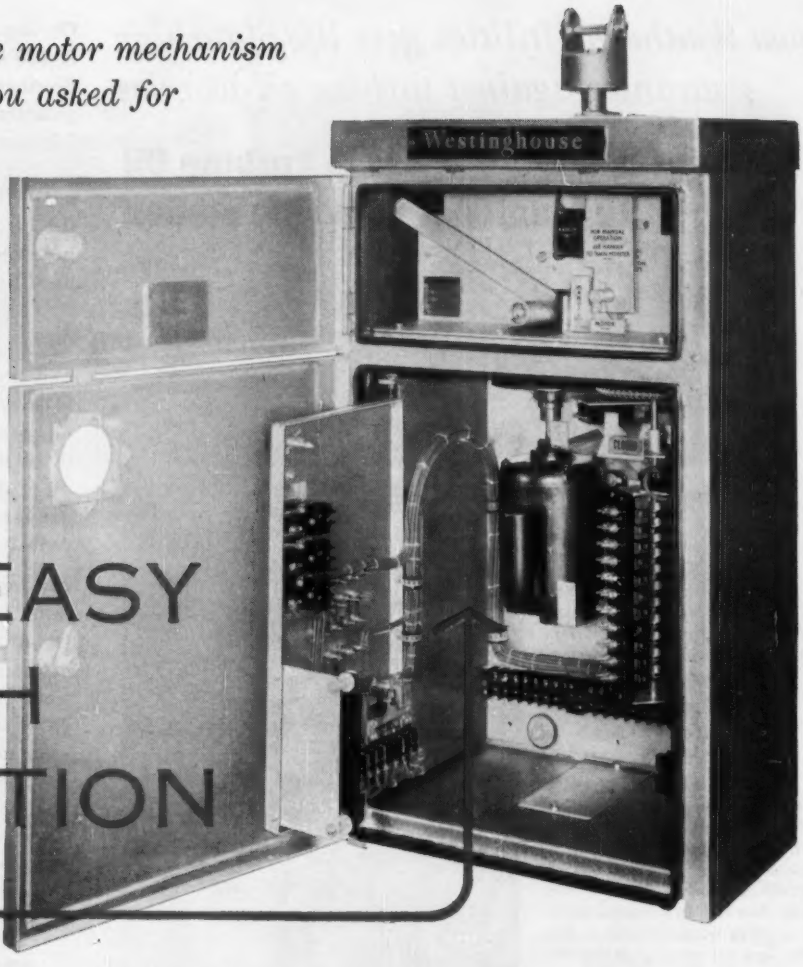
L. V. Hults and Jess Nelson inspect turbine oil returning to filter. Mr. Hults said, "The oil looks like new, and we've used it for four years."

Mr. L. V. Hults, Plant Superintendent (left), and Standard Oil industrial lubrication specialist, Jess Nelson, check instrument panel on one of Westinghouse turbines at Eddyville station. Jess Nelson is indeed qualified to serve accounts such as this utility. Jess has an engineering degree from the University of Iowa. He has completed the Standard Oil Sales Engineering School and has four years experience providing lubrication technical service.

STANDARD OIL COMPANY
(Indiana)

STANDARD

New Westinghouse motor mechanism with everything you asked for



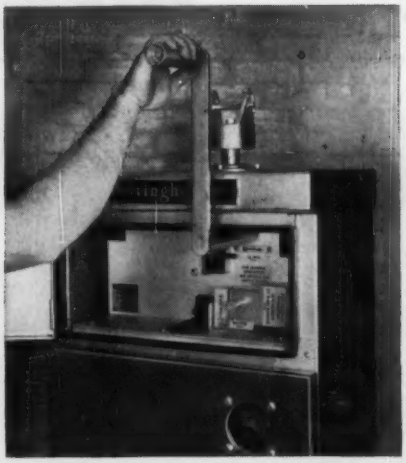
SAFE EASY SWITCH OPERATION

Here's a motor mechanism with the clean, attractive appearance so important in many switching locations.

The compact cabinet provides completely weather-protected manual operation as well as electric. Neoprene-gasketed doors give cabinet an effective weatherproof seal.

Swinging accessory panel simplifies wiring . . . makes entire mechanism readily accessible. Individually adjustable make-and-break auxiliary switch contacts. Roomy cabinet interior provides ample space for easy field hook-up, extra auxiliary contacts, additional terminals and heater.

For further information about Westinghouse Motor Mechanism or the complete line of Disconnecting Switches, contact your Westinghouse sales engineer or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-60934



The single crank handle, stored inside the enclosure, provides easy transition from motor to manual operation. No fuss with awkward accessories to change operation.

YOU CAN BE SURE...IF IT'S Westinghouse

Perfect Contact All the Time . . .
thanks to the NEW concept in shuntless switch design

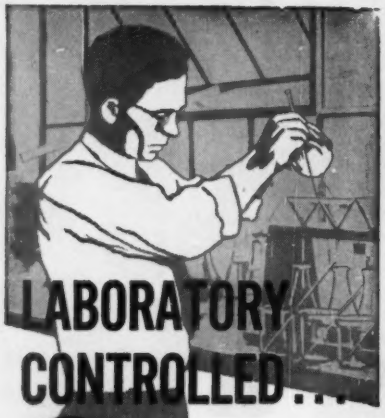
A new high in continuous and momentary current-carrying ability is reached with the latest Westinghouse innovation on the RL current transfer contacts. The heart of the rotating contact at both hinge and break ends (on RL type switches, rated 7.5 through 69 kv) is a split ring of compressed, silver-plated continuous copper ribbon that offers hundreds of individual point contacts for perfect operation every time. Of course, they are completely encased for absolute weather protection.

The split-ring contact is another advancement in the Westinghouse long-range development program designed to do a better job of serving the utility industries.

Let these Westinghouse quality features and advances work for you: weather-protected biasing springs assure positive positioning of break jaws; oilite bushings on all live-part bearings afford permanent lubrication; one-piece Beryllium cobalt-copper break jaws provide high-pressure line contact.

For complete information, contact your Westinghouse Salesman, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-60935

YOU CAN BE SURE...IF IT'S Westinghouse



Crapo

GALVANIZED STEEL STRAND FOR GUY, MESSENGER and OVERHEAD GROUND WIRE

The high, uniform, consistently-dependable quality of Crapo Galvanized Steel Strand is the direct result of close laboratory control over each step in manufacture. All wires used in forming a particular size and grade are produced from steel of selected analysis, carefully processed under technical supervision and stranded on precision machines. Both wire and finished strand are subjected to prescribed laboratory tests to insure the desired end result.

Heavy, uniform, tightly-bonded zinc coatings, applied by the famous Crapo Galvanizing Process, provide maximum resistance to corrosion.

Write for booklet OG-25 containing "Sag and Tension Data for Overhead Ground Wire."

INDIANA

STEEL & WIRE CO., INC., Muncie Indiana

Six electric units . . .

replace this old monster as . . .

Kwhrs Heat Lumber Office

R. L. SPENCER, Power Sales Engineer, Consumers Power Co, Battle Creek, Mich.

Electric heat is replacing other types of heating as far north as Michigan. Here in Battle Creek the Calhoun Lumber Co switched to blower-type electric heaters in February. These units, installed in the office spaces, replaced steam radiators supplied by the old boiler pictured above. Here's why Calhoun went to electric heat:

Heat distribution with the steam radiators was very poor. Persons in the offices were plagued with severe temperature differences.

Calhoun Lumber remodelled the office area, dividing it into five separate offices (each about 150 sq ft). Four were fitted out with single 1,500-w, blower-type heaters; the fifth with two units. Each office has its own on-off switch and thermostat.

Operating costs are estimated at $10.00 a month. The heaters are not submetered; hence, the estimmates. We expect that the winter months through February will raise these estimates to $20.00.

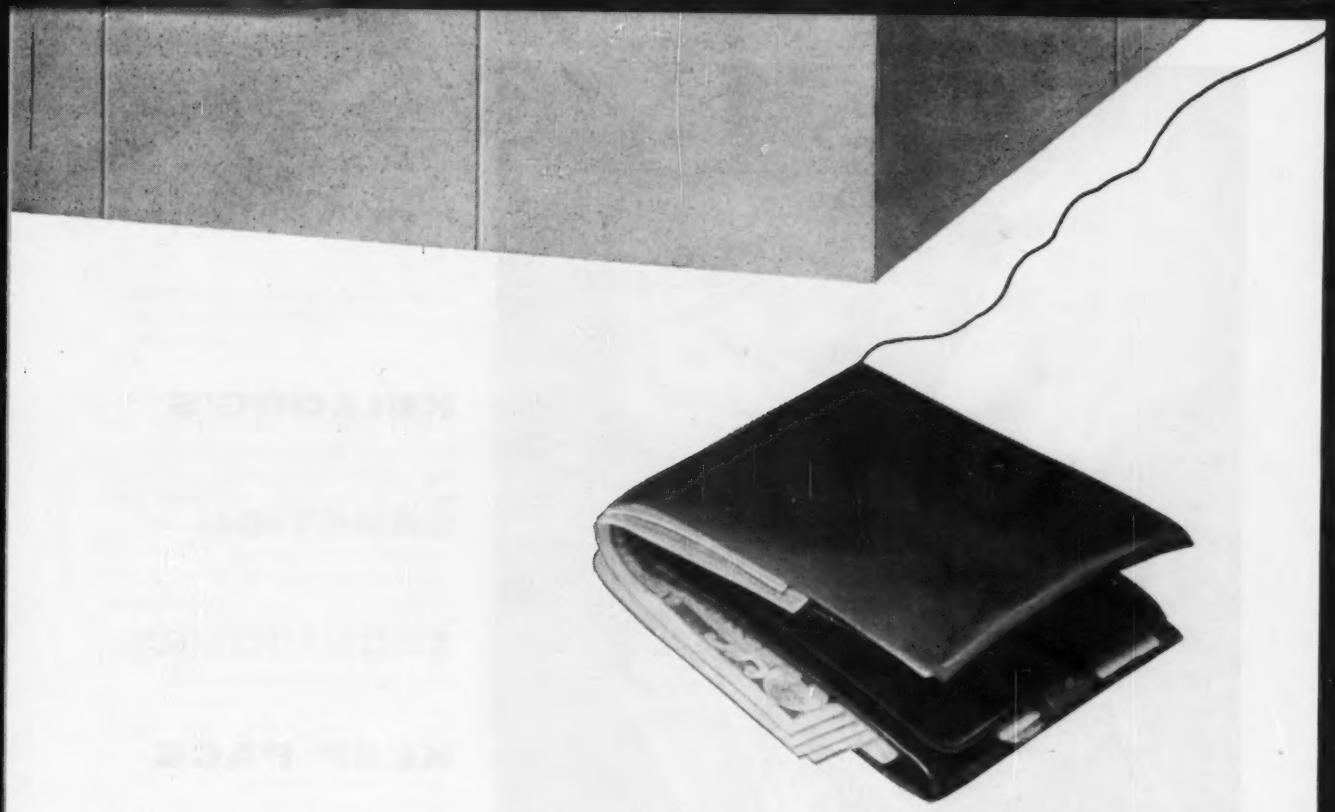
Are the Calhoun people satisfied with their electric heating? Evidently so. Says office manager Ken Ward, "We wouldn't think of trading it for any other type of heat."

Billing Data

Month	Kw	Kwhr	Cost	Heating Cost
March 1957	10	3,164	$76.30	$23.30
April	10	3,332	78.40	25.40
May	10	2,582	69.05	16.05
June	6.6	2,482	56.42	3.42
July	6.8	2,092	52.23*	....‡
Aug	6.4	2,254	52.93*	....‡
Sept	6.8	2,422	56.37	3.37
Oct	8.0	2,442	60.64	7.64
				$79.18

* Everything over $53.00 is attributed to heating load
‡ No air conditioning or other off-season loads

(More Selling on page 71)



GIVE-AWAY ...WITH STRING ATTACHED

Although many people are far too smart to fall for the old "lost wallet" trick, some still fail to see the string on the "public power" give-away. The time-honored April Fool stunt can only snatch away some money that the victim never had. "Public power" lifts his hard-earned cash right from his pocket.

What makes the "public power" issue much more insidious is the claim that the whole idea is to *prevent* a give-away: the giving away of power sites—natural resources that belong to everybody—to private power companies. The government, say "public power" advocates, can sell power much more cheaply.

And it does. Not that the government *produces* it for less—it has to pay the same costs of labor, tools, and materials that any private power company would have to pay.

But here's the string: Government power agencies are largely exempt from taxes. So are the investors in their securities. The savings in direct tax costs and finance charges enable these agencies to charge much lower rates for electric power and still show no deficit on their books.

Who then makes up the difference between what "public power" really costs and what the favored consumers pay for it? The public at large, the *taxpayer*.

Thus, for each $1 paid for electricity by customers of a private power company, some 23¢ goes for taxes. But people who buy their power from TVA, for instance, get off with taxes of only about 4¢ on the dollar.

So where's the give-away?

It occurs not under private enterprise but under "public power" development as practiced today.

The thing that's given away is not natural resources but the taxpayer's money.

And the favored groups are not private power companies but customers of "public power."

One question: Why shouldn't every American pay his fair share of taxes?*

*Based on material from The Guaranty Survey, published by Guaranty Trust Company of New York.

Leaflets, reprints and newspaper mats available at cost for publication of this message locally over the signature of your company. Address EW-2, Guaranty Trust Company of New York, 140 Broadway, New York 15, for further information.

GUARANTY TRUST COMPANY OF NEW YORK

140 BROADWAY, NEW YORK 15

Capital Funds in excess of $400,000,000

Fifth Ave. at 44th St., New York 36 · Madison Ave. at 60th St., New York 21
40 Rockefeller Plaza, New York 20 · London · Paris · Brussels

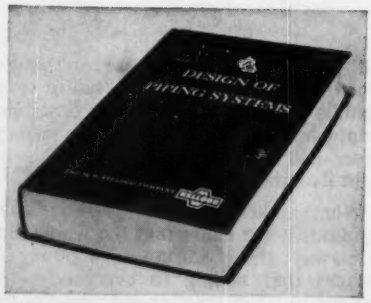
Member Federal Deposit Insurance Corporation

KELLOGG'S ERECTION TECHNIQUES KEEP PACE

K-WELD* is one of M. W. Kellogg's many advanced shop fabrication techniques which have been adapted by the company's construction department for field erection of critical power piping. A patented inert gas-shielded method of arc welding which eliminates backing rings and oxidation, K-Weld provides in field erection a smooth internal wall contour equal to that obtained under controlled shop conditions. For "average" as well as super-critical operating conditions, wherever the ultimate in welding is required, more and more power generating companies are turning to K-Weld.

A typical example is found currently in a 137,500 KW unit for a large eastern utility plant. Here, Kellogg is erecting the critical piping for the latest unit. Reheat piping, being K-Welded above, is 2¼% chrome-1% molybdenum alloy, 24.8750" OD, 1.1875" wall thickness. Main steam line is 10.906" ID, 2.410" minimum wall thickness, and 7.906" ID, 1.792" minimum wall thickness, and will operate at 1,940 psi, 1,000 F throttle temperature. For maximum performance, K-Weld is being used on both the main steam line and hot reheat line.

M. W. Kellogg welcomes inquiries on its complete service to the power piping industry from consulting engineers, engineers of power generating companies, and manufacturers of boilers, turbines, and allied equipment.



Kellogg keeps pace in theory as well as practice. This 400-page book is the most comprehensive work ever made available publicly on the design of power piping. This volume, now in its 2nd Edition, is published by John Wiley & Sons, Inc., New York.

FABRICATED PRODUCTS DIVISION
THE M. W. KELLOGG COMPANY, 711 THIRD AVENUE, NEW YORK 17, N. Y.
A SUBSIDIARY OF PULLMAN INCORPORATED

The Canadian Kellogg Company Ltd., Toronto • Kellogg International Corp., London • Kellogg Pan American Corp., New York • Societe Kellogg, Paris • Companhia Kellogg Brasileira, Rio de Janeiro • Compania Kellogg de Venezuela, Caracas

KELLOGG

POWER PIPING—THE VITAL LINK

*Trademark of The M. W. Kellogg Company

Rejects Drop, Output Grows with Novel A.C.

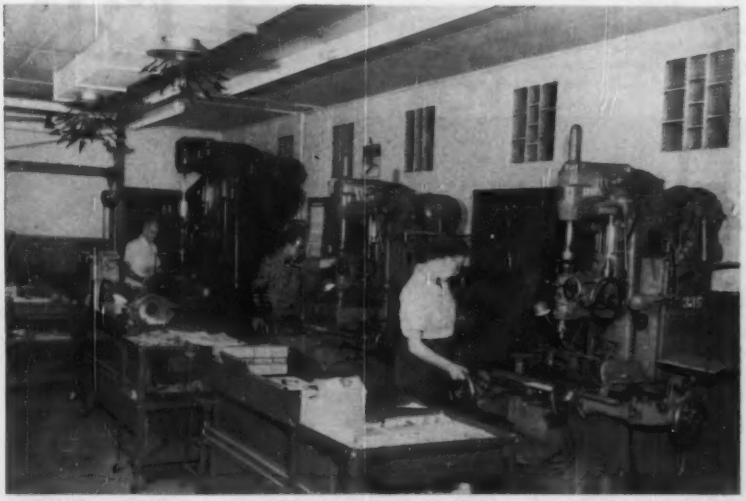
L. ALBERTSON, Supervisor Sales Application Dept., Philadelphia Electric Co, Philadelphia, Pa.

Combining an air conditioning unit with the central heating system to produce a temperature controlled room for precision machining has paid handsome dividends at Hires Castner & Harris in Philadelphia. Among the benefits: faster production, fewer rejects, and better working conditions.

A 5-ton air conditioner connected to the heating duct that feeds the 20 x 40-ft corner room helps hold the room temperature at 72 F year 'round. As a consequence, components for defense production can be bored with precise uniformity. Fewer machine adjustments are required. Materials are saved by reduction in rejects. With all the windows closed, there are fewer foreign particles in the air and less maintenance is required.

Another important advantage is that the workers are isolated from other plant activity, have fewer distractions to disturb concentration or cause errors in calculation. Workmanship has improved now that employees are no longer subjected to excessive heat and humidity.

Hires Castner & Harris have been designers and builders of special automatic machinery for over 40 years. In addition to defense production, their products are used in the chemical, automotive, food, paper, and textile industries.



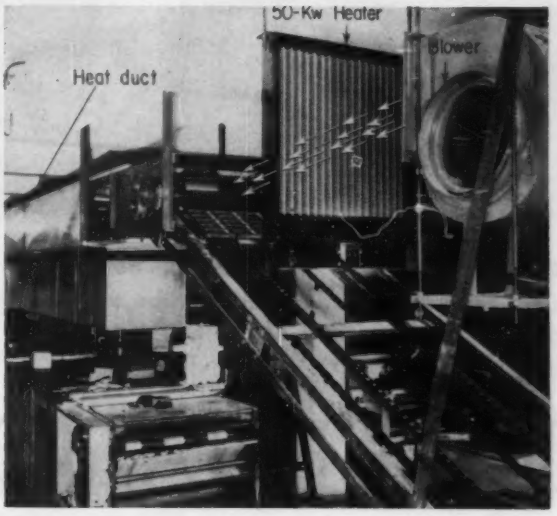
CONNECTED TO HEATING DUCT that serves machine shop, 5-ton air conditioner helps assure year 'round 72-F temperature. With clean air, maintenance is less

Candy Output Climbs as Steam Yields To Electric Heat

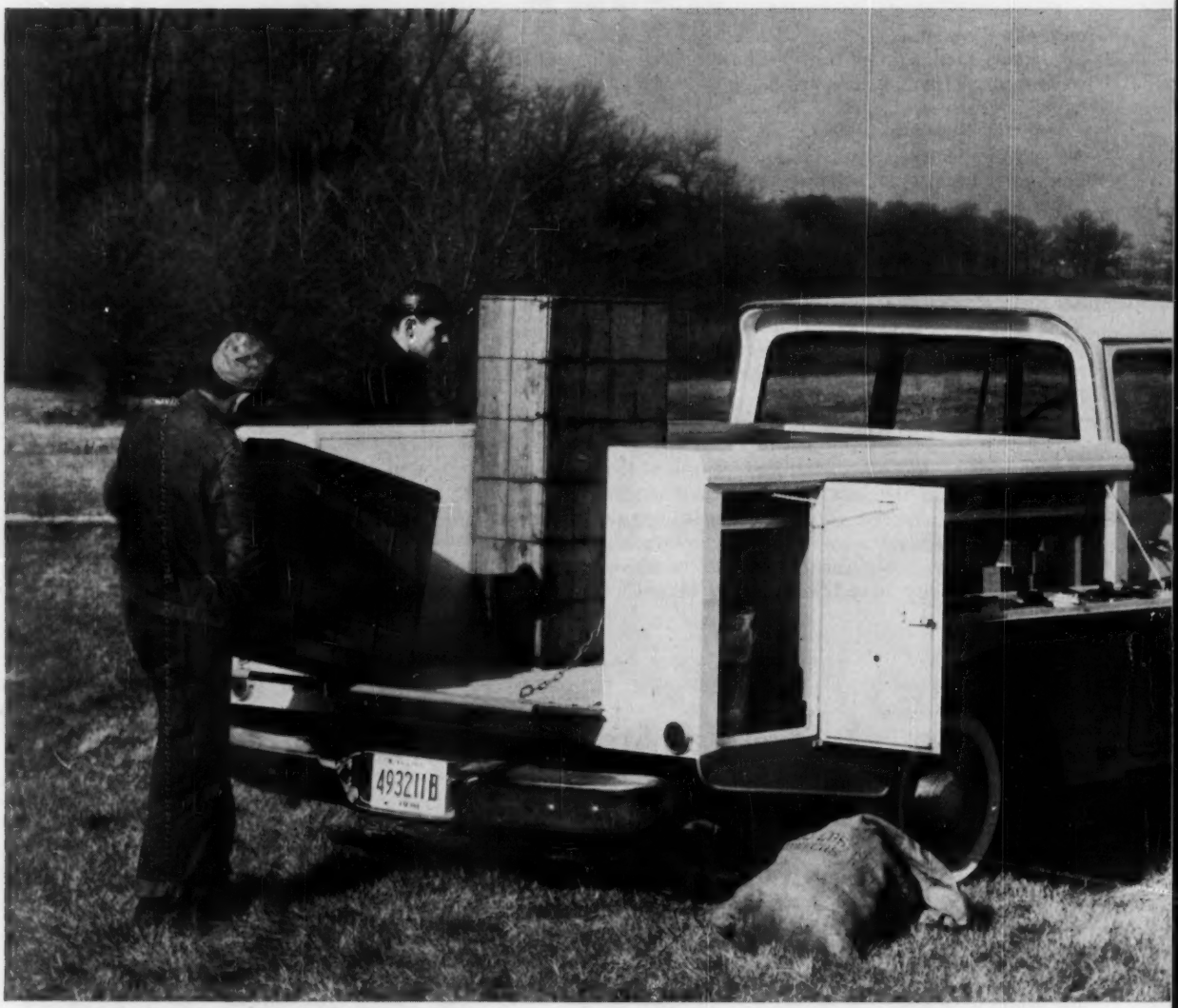
NORMAN S. HARTMAN, Power Sales Engineer, Pennsylvania Power & Light Co, Columbia, Pa.

A 50-kw resistance heater used to pre-heat molds for candy at the Bachman Chocolate Manufacturing Co, Florin, Pa., has paid off in closer temperature control, increased production, and freedom from condensation problems. A 3-hp motor forces the warm air from the heater over the molds as they are conveyed through an insulated duct. Temperature inside the duct is thermostatically controlled. At the far end of the duct, the molds are filled with chocolate syrup, and then carried to a 40-degree F cooling duct.

To obtain a superior and uniform chocolate product, the molds have to be tempered before the syrup is poured into them. The previous system used steam radiation with forced air circulation. It produced condensation and generally poor operating conditions. The conversion was simplified by the fact that the superintendant attended the IEC sheath heater course.



New International Travelette!



Another INTERNATIONAL first—the new Travelette. This is the truck that can take a six-man crew to and from field jobs, with up to a full ton load capacity!

THE TRAVELETTE combines smart styling and roomy cab with a rugged INTERNATIONAL Truck chassis and 7-foot factory-installed service utility body . . . all in one money-saving unit! 6-foot pickup body also available. Saves the double expense of a car *and* pickup.

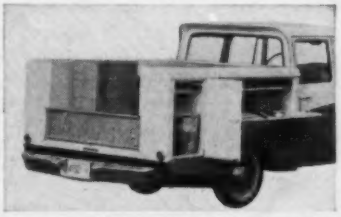
INTERNATIONAL TRUCKS

Carries 6 passengers plus a full equipment load!

You get exactly the right power for your needs from a complete choice of engines. And you can have four-wheel-drive for extra traction. Check with your INTERNATIONAL Dealer now about a new Travelette. Like all INTERNATIONAL Trucks, it costs *least* to own!

cost least to own!

Full-width seating front and rear! Six passengers can ride in roomy, cushioned comfort. Plenty of visibility and ventilation. Three-door cab for easy in-and-out.



Factory-installed service-utility body! Body is of proven design, with time-saving compartments for tools and gear. Lots of load space.

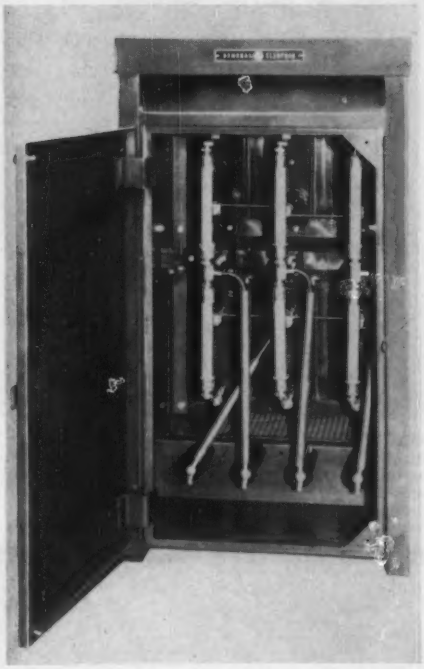
Four-wheel-drive model available! Takes crew and equipment right to the job, on or off the road. Dependable traction in rough or slippery going.

Big load capacity! The Travelette offers up to a full ton load capacity. Pickup load space 90 inches with tailgate down.

INTERNATIONAL HARVESTER COMPANY, CHICAGO
Motor Trucks • Crawler Tractors
Construction Equipment • McCormick®
Farm Equipment and Farmall® Tractors

Season's Greetings

MOLONEY ELECTRIC COMPANY



Capacitor Equipments

. . . are housed for indoor and outdoor use on primary distribution circuits. They may be installed close to low-power-factor loads.

Standard 3-phase equipment consists of weatherproof housing, single-phase capacitor units, buswork, fuse clips, and one current-limiting fuse per capacitor.

Equipments are rated 45 to 180 kvar at 2.4 or 4.16 kv; 90 to 180 kvar at 4.8 or 7.2 kv.

Underground entrance for either cable or conduit is made through a plate in the bottom of the equipment. Solderless clamp-type connectors and lifting lugs on the all-welded steel housing speed installation.

General Electric Co, Capacitor Dept, Hudson Falls, N. Y.

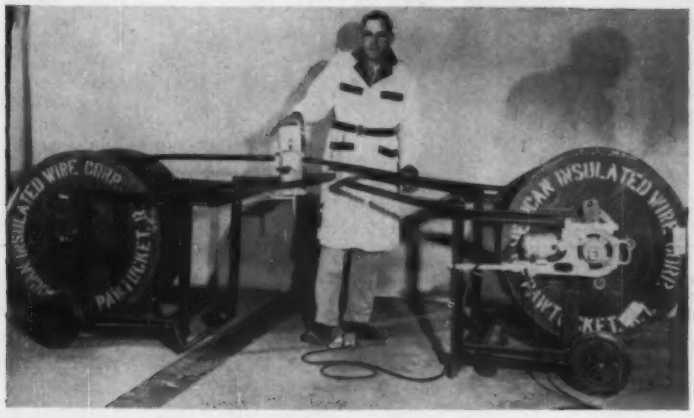
Low-R Ohmmeter

. . . measures down to 10 microhms to check resistance of connectors, joints, contacts, and windings in oil circuit breaker assemblies, rotating equipment, transformers, and coils.

Instrument has four ranges, reads directly on open 3¼-in. scale and weighs 10 lb. Current circuit contains automatic breaker.

Battery- or rectifier-powered models are available.

James G. Biddle Co, 1316 Arch St, Philadelphia 7, Pa.



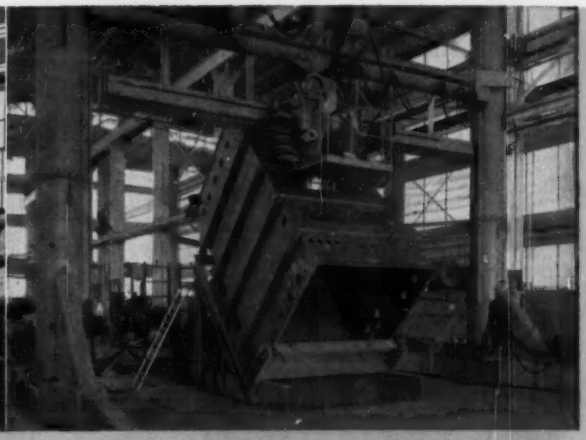
Portable Power Reels

. . . re-reel cable from one drum to another. Power drive can also pull cable through conduit. Kit consists of two carts with shaft, reel bushings, and wire leveler. One cart includes also power drive unit, CVM meter, and locking device. Two kits are available: one for 2,000-lb reels up to 32 in. wide; the other for up to 42-in., 3,000 lb reels.

Weber Electrical Mfg Co, Inc, 15524 Kercheval Ave, Detroit 30, Mich.

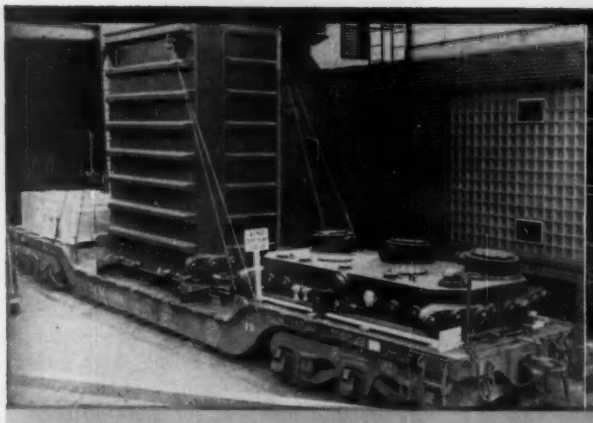
(*More New Equipment on page* 78)

ADVANCED ENGINEERING DESIGN . . . Wagner engineers, specialists in transformer design, have the skill and experience to design the best possible transformers today—and even better ones tomorrow. This knowledge is incorporated in every special transformer design and in Wagner standardized units as outlined in ASA Standards C57.12b.



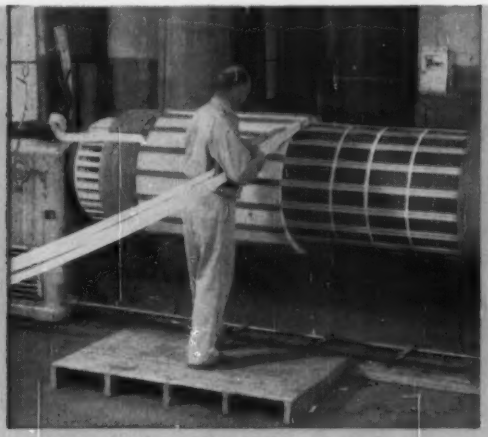
WELL CONSTRUCTED TANKS... Wagner builds all tanks for its transformers. Huge brake presses bend the steel plate smoothly. All seams are uniformly welded by the submerged arc method to insure continuous leak-proof welds that mean longer-lasting transformers.

Quality is what you get in Wagner Power Transformers



SPECIALLY EXPEDITED SHIPPING... Railroad cars are brought right into Wagner's power transformer bay for loading. Main line railroads pass the Wagner plant for expedited shipments to all parts of the country.

FIELD INSTALLATION SERVICE... Wagner field service trucks, manned by trained service engineers, are available, at nominal cost, to help install new transformers, or to make repairs when necessary... another reason why it pays to specify Wagner.



CAREFULLY WOUND COILS... Low voltage helical coils are continuously wound on insulating cylinders of high dielectric strength. High voltage coils are wound with buffer coils at each end for protection against any surges that might be encountered on a properly built transmission line or a substation.

EXACTINGLY BUILT CORES

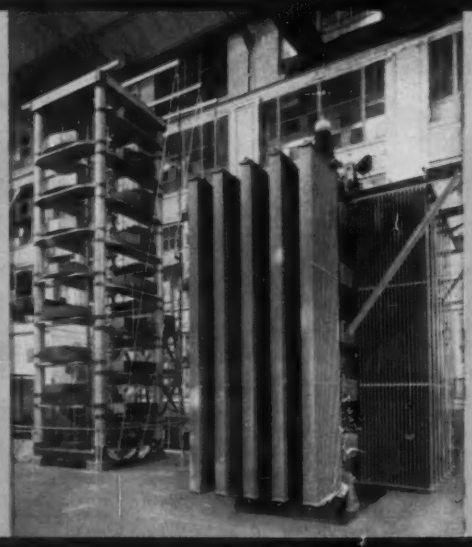
The electrical steel sheets used for core laminations must meet the most rigid specifications. Laminations are annealed at carefully controlled temperatures to assure low core loss. Core laminations, with oil duct spacers, are individually stacked over insulated bolts.

EXPERT ASSEMBLY

Core and coil assemblies are carefully insulated. All moisture and trapped air that might cause hot spots is removed in special vacuum tanks. Extreme care and skill is exercised in every assembly step.

RIGID INSPECTION AND TESTING

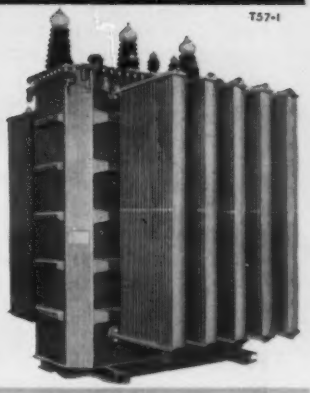
Wagner transformers are given all prescribed commercial tests ...and every new design is subjected to impulse tests to assure that the transformer will perform as designed.



T57-1

That's why it's to your advantage to specify Wagner

The extreme care given Wagner Power Transformers—from inception to installation—has one objective . . . to build the best possible transformers that will give you years of completely dependable service. Consult Wagner about your next power transformer installation. Thirty-two branch offices are at your service. Write for Wagner Bulletins TU-181 and TU-16D.



Wagner Electric Corporation
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.

Wagner Electric Corporation
SERVING INDUSTRY SINCE 1891

LIVE BETTER ELECTRICALLY

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

Current Transformer . . .

. . . of laboratory type measures power of low power factors down to 3%. Phase angle error is 2.4 min leading. Accuracy is 99.5%. Current rating is 500: 5 amp. The transformers can be made in a range from 1 to 10,000 amp.

Each transformer is tested for core loss, polarity, voltage, corona, insulation breakdown and aging characteristics before shipment.

Nothelfer Winding Laboratories, Inc, Box 445, Trenton, N. J.

Silicon Power Rectifiers

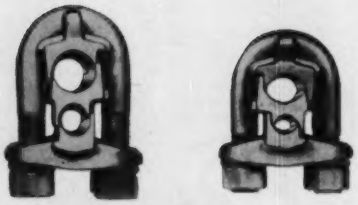
. . . provide 250 v dc for industrial service. Units are available in a-c input ratings under 600 v, 3-phase, 60-cycle. D-c outputs run 75 to 600 kw for two-wire 250-v systems, 75 to 150 kw for three-wire 125-250-v systems. D-c circuit breaker gives protection against d-c overloads and shorts.

General Electric Co, Schenectady 5, N. Y.

Motors . . .

. . . have all-aluminum frames in sizes 182 through 362U. The light aluminum-alloy motors are rated ½ to 40 hp—drip-proof or totally enclosed fan cooled. Other features include NEMA face and flange endbells.

Reuland Electric Co, Alhambra, Cal.



Parallel Clamps . . .

. . . give peripheral enclosure of conductors from maximum to minimum size. Wrap-around construction keeps sides of center spacer always in contact with cap and bottom plate, forming continuous wall of metal that completely encloses conductor. This minimizes cold flow and gives high pull-out.

Clamps come with one, two, or three aluminum-alloy U-bolts. They take aluminum, ACSR, or copper conductors from No. 6 to 900 Mcm.

Penn-Union Electric Corp, Erie, Pa.

MORE NEW PRODUCTS

Surface lubricant replaces paraffin coating on type TW, machine-tool wire, and "Flexall."—Rome Cable Corp, Rome, N. Y.

Radiant heater takes only 10¾ x 8½ in. of wall space to heat a 9x6-ft room. It mounts flush with wall and is easy to install.—Markel Electric Products, Inc, & La Salle Products, Inc, Buffalo, N. Y.

Pressure switch for industrial process control is remotely adjustable without a servo system. Accuracy is 2 mm Hq in range from 0 to 15 psia.—Trans-Sonics, Inc, Burlington, Mass.

Light-weight stationary **batteries** for switchgear, control, signaling, emergency light and other applications have capacity range from 40 to 960 amp-hr.—Gould-National Batteries, Inc, Trenton 7, N. J.

Power speaker allows a driver to hear incoming messages when working ½ mi away from his vehicle. Cast aluminum speaker is rugged and weatherproof.—Motorola Inc, Communications and Industrial Electronics Div, 4501 W. Augusta Blvd, Chicago 51, Ill.

Custom-made **nameplates** have aluminum letters on black background. Plates are 0.02-in.-thick aluminum.—The Henry G. Dietz Co, 12-16 Astoria Blvd, Long Island City 2, N. Y.

Motor bases provide automatic tension control of short-center belt drives up to 250 hp.—The American Pulley Co, 4200 Wissahickon Ave, Philadelphia 29, Pa.

Compact, air-cooled 200-amp silicon **rectifier junctions** for industrial applications withstand shock and are easy to install. Junction and heat exchanger are integrated.—International Rectifier Corp, 1521 Grand Ave, El Segundo, Cal.

Inert gas **welding outfit** has its own water supply. Rust-proof tank holds 20 gal. Pump is coupled to ⅓-hp motor for operation on single-phase 60-cycle, 110-v power.—Hobart Bros. Co, Hobart Sq, Troy, Ohio

Marking nails for line poles are made to order with a number, letter, or combination raised or depressed on head.—John Hassall, Inc, Westbury, L. I., N. Y.

"Twin" **recorders** in a single case measuring 19 x $16\frac{3}{16}$ in. can be mounted on a 19-in. relay rack. Chart speeds from ¼ in. per hr to 120 in. per min are available.—General Electric Co, Schenectady 5, N. Y.

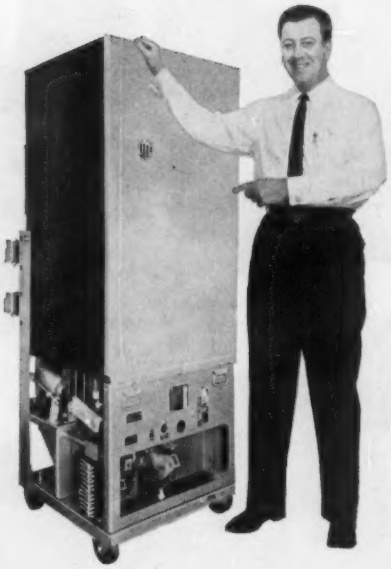
Insulation tester measures resistances from 1 to 50,000 megohms in four overlapping ranges. Calibration circuit uses standard commercial tubes and meter tracking control. Other features are simple operation and a regulated 500-v test potential. — Associated Research, Inc, 3758 W. Belmont, Chicago 18, Ill.

Flexible, liquid-tight **conduit** has heavy extruded PVC jacket, permits smaller bending diameters than the conduit it replaces.—American Brass Co, American Metal Hose Div, Waterbury, Conn.

Toroidal winding and taping machines feature simultaneous, separate, or sequential 360-deg continuous winding of wire or tape in one operation. One unskilled operator can run it.—Universal Mfg Co, Inc, 410 Hillside Ave, Hillside, N. J.

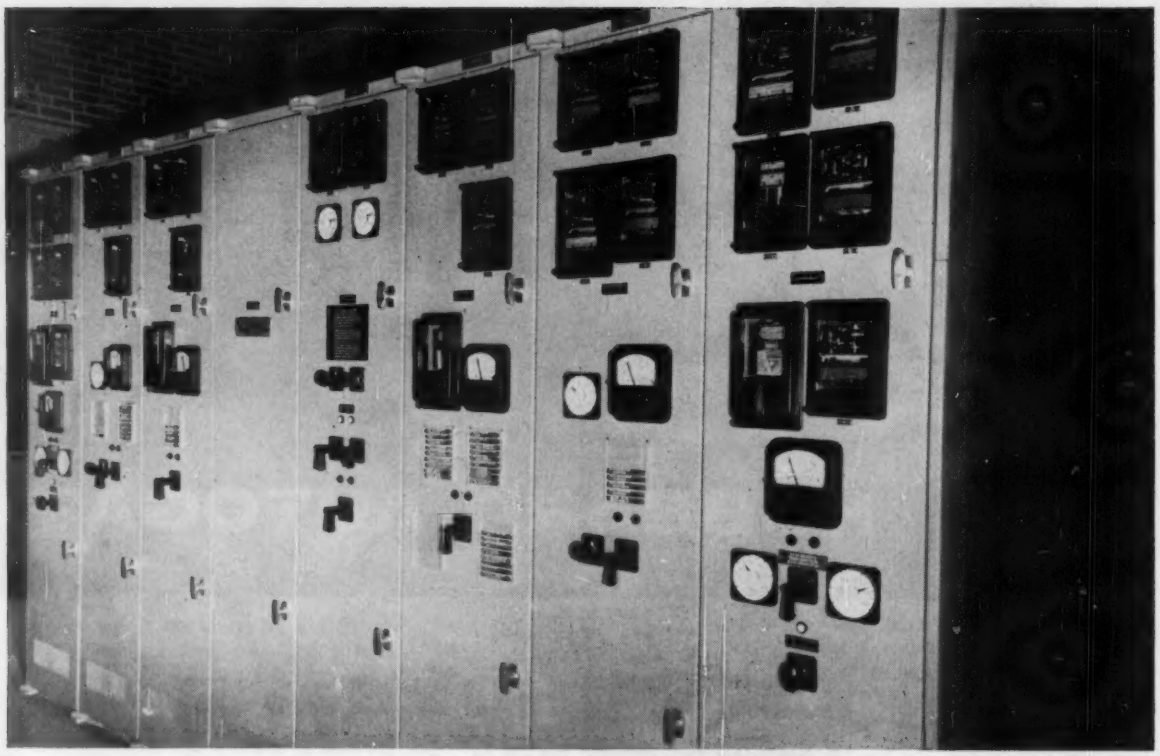
HUBBARD
AND COMPANY
Pittsburgh • Chicago • Oakland • Plano, Texas

First 5 kv Breaker in



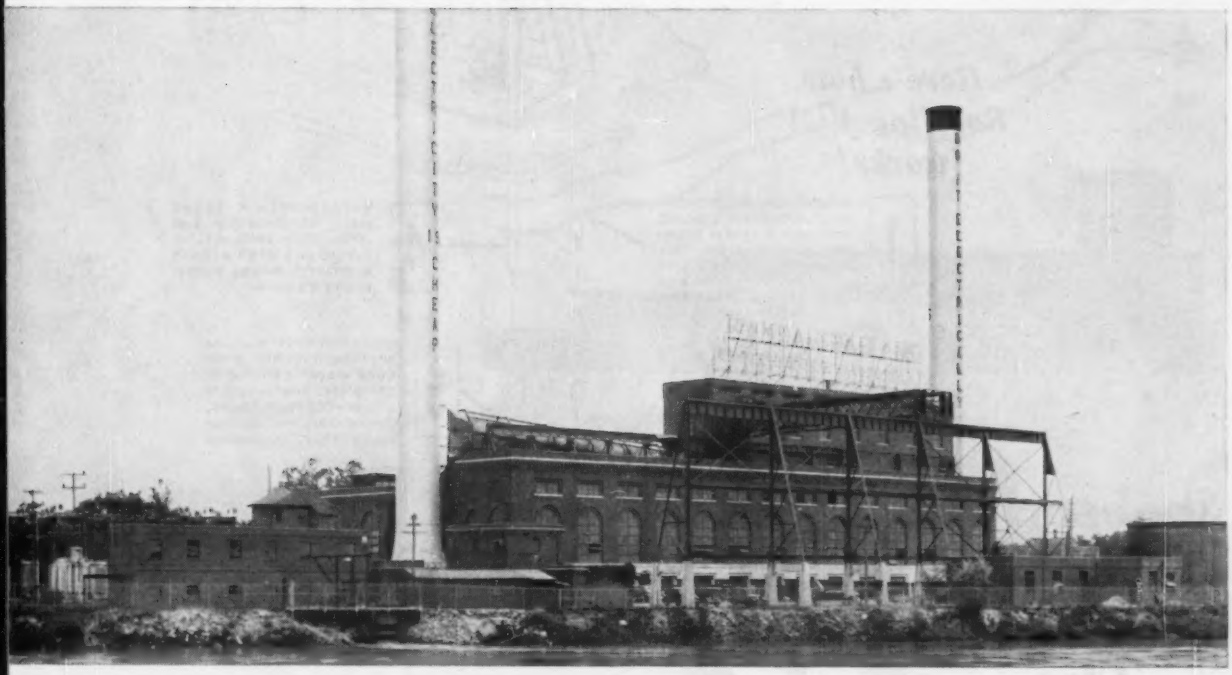
I-T-E leads again. Three installations already. More coming soon.

First 350 mva air magnetic circuit breakers to be developed in the 5 kv class. First to be installed. First to be operating. This latest electrical progress reflects I-T-E's constant effort to extend the ratings of modern metal-clad switchgear. And as with all I-T-E equipment, these new circuit breakers are made with I-T-E's traditional emphasis on sound engineering and quality construction. Available now in 1200 and 3000 amp continuous current ratings. Write for technical details on your specific application.

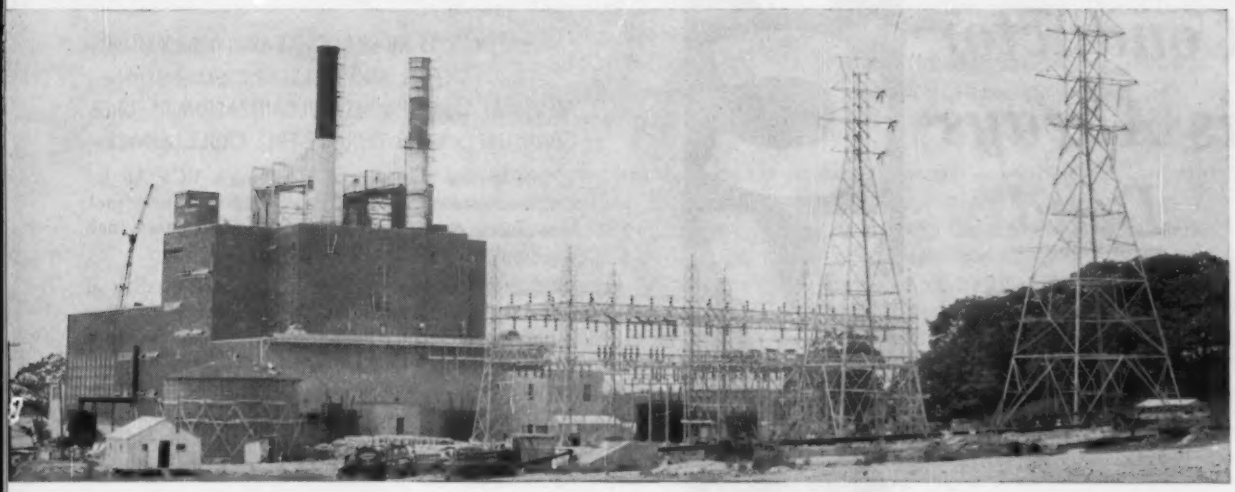


Installation at Esso Standard Oil Co., Baton Rouge, La.

350,000 kva Rating



Kansas Gas and Light Co., Wichita, Kans.



Central Maine Power Co., Augusta, Maine

SWITCHGEAR DIVISION

I-T-E CIRCUIT BREAKER COMPANY

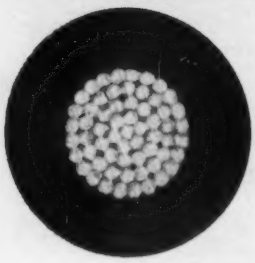
19TH AND HAMILTON STREETS, PHILADELPHIA 30, PENNSYLVANIA

2
Conductor is put under controlled tension, which is maintained during entire insulating process.
3
Butyl insulation is extruded downward around conductor.
Here's how Roebling VCV works!
1
Strand wrapped in semi-conducting tape goes up through 4-story, high-temperature tube. This drives out gases and moisture from core, and preheats the conductor for more uniform curing.
4
Vulcanization takes place continuously and uniformly in vertical tube. Constant high steam pressure assures dense, sound insulation.
5
Insulation never touches anything until high-pressure water cooling is complete. The result is unvarying roundness, smoothness and concentricity of butyl insulation.

The Conductor is Always Dead Center

ROEBLING

VCV



ROEBLING'S 15 KV CABLE HAS UNIFORMLY HIGH CORONA LEVEL AND DIELECTRIC STRENGTH. VERTICAL CONTINUOUS VULCANIZATION ASSURES UNUSUALLY LONG TROUBLE-FREE CABLE SERVICE.

If you sliced a length of Roebling's VCV 15 kv Cable into cross sections, you'd find that *every inch* is uniform, every inch is round, and in every inch the conductor is exactly centered!

VCV is responsible for the exceptional quality of this new high-voltage cable. No longer will you buy cables in which the conductor has "snaked," or that has flattened, scraped, blistered or abraided insulation. Because insulation is the same thickness and density for the length of the cable, dielectric strength and corona level are uniformly high.

ROEBLING VCV 15 kv CABLES are available in a complete range of conductor sizes and insulation thicknesses

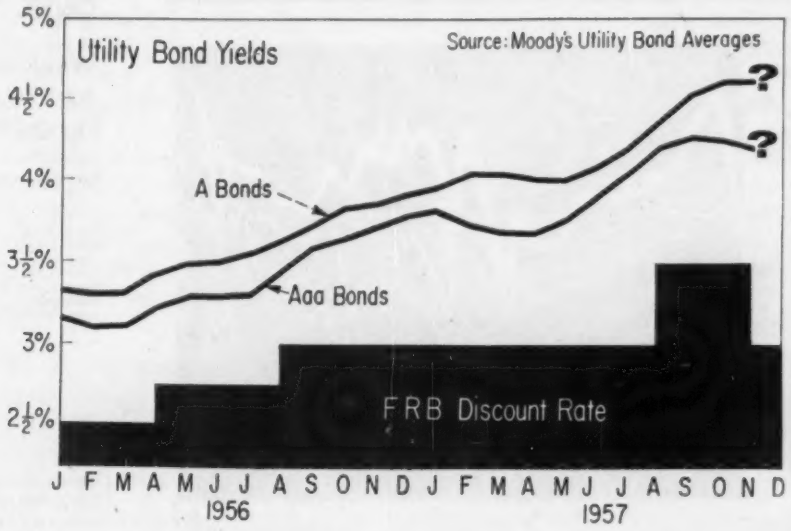
Write today for more facts about the longer, better service you'll get with Roebling VCV High-Voltage Cable. Electrical Wire Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

ELECTRICAL BUSINESS OUTLOOK

Electrical World
DECEMBER 23, 1957



Where Are Bond Yields Headed?

Utility bond yields have turned down. They took a dramatic plunge following the Federal Reserve Board's recent reversal of its "tight money" policy. Waiting buyers decided, when the Fed announced its intention to ease credit, that now was the time to buy. And they did, cleaning dealers' shelves.

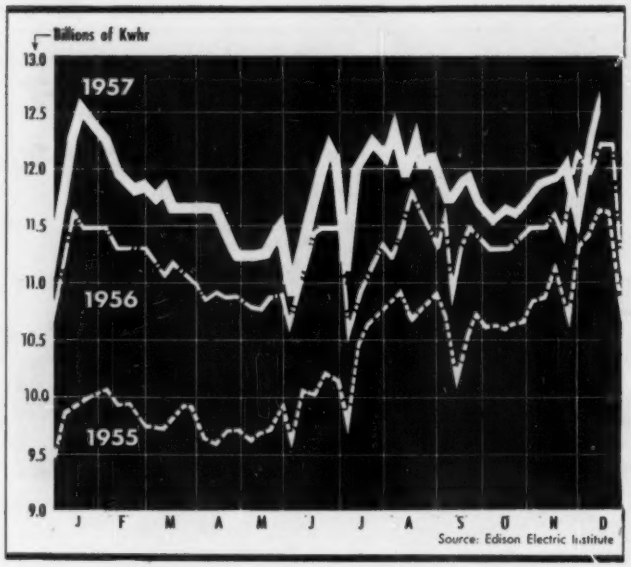
Here's a striking example of what such a turn can mean to utilities. On Oct. 30, American Telephone & Telegraph Co sold $250 million in bonds. Yield to the public was 4.90%. Six weeks later a subsidiary, Chesapeake & Potomac Telephone Co, sold $30 million worth at a 3.98% yield. The measure of difference is just this. If AT&T had been able to put over its $250 million issue at 3.98%, it would have saved better than $50 million over the 26-year term of the bonds.

It looks like money will stay easy for the next six months or so. Next development to watch for is a drop in the prime rate of interest charged by banks to risk-free customers. And the Fed is expected to leave credit in the market after Christmas, instead of sopping it up through sale of government bonds, as it usually does. Reserve requirements of member banks may possibly be lowered; and there is a remote possibility that the discount rate may be shaved further if the Fed feels it necessary in order to get business turned around and headed up again

But don't look for this month's sharp drops in yield to continue into 1958. And don't read too much into the Fed's policy reversal. For two years, like a tugboat berthing an ocean liner, the Fed has been exerting a steady shoreward pressure on the economy. Recent action merely indicates that the Fed has noticed it has pushed too hard, and is now nudging the economy vigorously from the other side—to keep it off the rocks. When momentum stops, so will the Fed.

General business conditions will determine the '58 money market—not the Fed. If business turns up, demand for money will turn up. And this will tend to push bond yields up. The Fed will be watching year-end business closely and planning its moves accordingly from week to week. Only if the economy fails to respond to treatment will money get much cheaper than it is now.

STATISTICS



OUTPUT

Week ended December 14, 12,570,000,000 Kwhr Up 2.9%

Per Cent Change From Previous Year

	Nov. 30	Dec. 7	Dec. 14
Total U. S.	−3.8	+2.2	+2.9
New Eng.	−6.6	+2.9	+1.2
Mid. Atlan.	−4.6	+2.3	+2.3
Cent. Ind.	−7.2	+0.1	+0.0
West Cent.	−2.5	+1.6	+1.5
Southeast	−3.8	+4.8	+7.1
South Cent.	+4.7	+4.2	+5.8
Rocky Mount.	+1.8	+2.1	+2.8
Pacific			
NW	−1.9	−2.5	−2.3
SW	−2.0	+4.7	+5.9

Seasonally Adjusted Index 228.9
Week Ago 227.6
Year Ago 222.3

Atomic Energy Commission requirements—1,050,000,000 Kwhr (Electrical World estimate). Excluding AEC, output increase was 3.8%

Power Statistics . . .

		Latest Month	Preceding Month	Year Ago	Annual Change %
Capacity	Sept.	126.24	125.75	118.66	6.4
Peak—Class 1 Systems (million kw)	June	104.6	97.8	97.2	7.6
Estimated Dec. '57 Peak (million kw)	Sept.	112.8	113.0	114.8	−1.8
Production—billion kwhr	Sept.	51.57	55.45	48.82	5.6
Hydro		9.28	10.03	8.96	3.6
Fuel		42.29	45.42	39.86	6.1
Sales—billion kwhr	Sept.	49.01	49.79	46.18	6.1
Residential		12.86	13.05	11.67	10.2
Commercial		8.59	8.76	7.82	9.8
Industrial		24.76	25.06	23.97	3.3
Other		2.80	2.93	2.71	3.3
Fuel Consumption	Sept.				
Coal—million tons		12.75	13.33	12.45	2.4
Oil—million barrels		5.64	5.79	5.20	8.5
Gas—billion cu ft		137.60	160.96	124.63	10.4
Net Income Class A & B Co's $—million	Sept.	116.13	108.86	108.33	7.2
Residential Customers—millions	12 mos	46.61	46.49	45.39	2.7
Revenue per kwhr	ended	2.57¢	2.57¢	2.61¢	−1.5
Avg kwhr per customer	Sept. 30	3,121	3,104	2,929	6.6
Avg annual bill		$80.21	$79.77	$76.45	4.9

Business Statistics . . .

Indexes: 1947–49 = 100					
FRB Industrial Production	Nov.	141	145	147	−4.1
ENR Construction Cost	Dec.	154.7	154.6	147.6	4.8
BLS Cost-of-Living	Oct.	121.1	121.1	117.7	2.9
New Orders for Machinery (1950 = 100)	Oct.	119	141	139	−14.4
NEMA Sales					
Insulation materials	Oct.	133	135	163	−18.4
Electric appliances		88	97	94	−6.4
Wholesale prices	Oct.				
Motors and generators		143.0	143.3	136.9	4.5
Transformers and regulators		150.8	150.8	144.8	4.1
Switchgear and fuses		170.9	170.6	161.9	5.6
GNP—annual rate—$ billion	3d qtr.	439.0	434.3	416.7	5.4

MANAGEMENT BULLETIN

FINANCE ▶ **Common stock issues for electric companies** listed on the New York Stock Exchange showed a good upward tone for the week ending December 13. Those stocks with a point or more increase were: Atlantic City Electric Co, Boston Edison Co, Central Illinois Public Service Corp, Cincinnati Gas & Electric Co, Cleveland Electric Illuminating Co (led the parade with a gain of $2.25), Columbus & Southern Ohio Electric Co, Dayton Power & Light Co, Gulf States Utilities Co, Houston Lighting & Power Co, Idaho Power Co, Indianapolis Power & Light Co, Louisville Gas & Electric Co, Montana Power Co, Ohio Edison Co, Oklahoma Gas & Electric Co (registered a $2 increase), Public Service Co of Colorado, Puget Sound Power & Light Co, Washington Water Power Co, and Wisconsin Electric Power Co.

EMPLOYEE RELATIONS ▶ **About 57% of students are planning to enter professional and technical occupations.** This was revealed in a recent survey of 2,000 students in 21 northern California high schools, junior colleges, and colleges. Conducted by the San Francisco Sales Executive Association, the poll showed another 14% going for clerical positions and 12% for sales and crafts.

As part of the management team are you using the 4 R's in dealing with your employees? The 4 R's are: Recognition, Respect, Responsibility, and Reward.

Kansas Power & Light Co hosted about 40 members of the engineering faculties of the University of Kansas and Kansas State College recently. The "KU-KSC-KPL Joint Engineering Meeting," as it was called, was used to acquaint the engineering professors with KPL's new 90,000-kw addition to its Tecumseh generating station, east of Topeka. An evening meeting was devoted to discussions of engineering education and practices.

DUQUESNE LIGHT ▶ **Duquesne Light Co's earnings** are expected to exceed $2.50 a share for 1957 as compared with $2.44 in 1956 and $2.33 in 1955, Board Chairman P. A. Fleger told the New York Society of Security Analysts recently. This gain reflects ten-month sales 4% above the corresponding period of last year with a 5% gain in revenue. The increase came mostly from residential consumption which ran 12% over last year for October, after a slowdown in the spring, and now seems likely to exceed the 8½% increase reflected in the company's 1957 budget, Fleger continued. This growth reflects appliance sales above the 1956 rate for the Pittsburgh area. Commercial consumption has been 10% over 1956 for the first ten months. But industrial consumption is expected now to run slightly below 1956 for the current year.

P. A. FLEGER

A rise of 9% in coal cost was of considerable concern to Fleger. This, he said, reflected the wage boost in the 1956 United Mine Workers contract and rising costs of mine supplies. But he suggested that further rise in coal cost would not occur unless the labor contract is terminated by UMW. His company's wages took a 4¾% jump in October.

For 1958, Fleger predicted continued growth of residential and commercial load at rates only slightly below 1957. He said industrial sales would remain at the 1957 level because one large customer will energize a private plant during the year. Revenue will increase somewhat more than power sales for a small increase in earnings.

How about construction? Duquesne's 1¼-million kw of generating capability will gain 60,000 kw when the Shippingport nuclear plant goes into commercial

service about the first of the year. And a conventional unit under construction will add 172,000 kw early in 1960, Fleger said.

A new $15-million bond issue is planned for the first half of 1958 to retire $7 to $8 million of bank loans and finance construction at the current rate of $27 million a year. New stock offerings are not contemplated before 1959, the Duquesne Light chairman noted.

About $3 million has been retained for expansion from the application of accelerated depreciation for tax purposes, Fleger admitted. The effect has not been applied to rate making because regulatory requirements have not been clarified and an adverse decision could leave deficient revenues.

RATES ▶ **Gulf Power Co gets an order from the Florida Utilities Commission** to cut rates by $257,000 a year by January 1 or face a public hearing early in 1958. Lewis Petteway, chief attorney for the commission, said the company's rate of return under the rates ordered would be 6.9%.

EARNINGS ▶ **Earnings of 810 companies** increased 11% in the third quarter of 1957 over a like period of 1956, a First National City Bank survey shows. By coincidence, earnings of 76 electric and gas utilities included in the report increased by the same percentage. These increases, in terms of net income, are sometimes fallaciously taken as reflecting an increase in earnings on an equal amount of equity invested in the periods used in the comparison. Of course this is not the case, as the comparison does not reflect additional amounts invested through the sale of preferred and common stocks and through retention of earnings for use in the business.

As electric utilities have greater than average percentage expansion, this factor is particularly important in that industry. Common stockholders of electric utilities may avoid this conclusion, so far as sales of additional equity securities are concerned, by comparing the per share earnings on the common stock rather than net income.

When new equity capital is supplied by the sale of securities, on proceeds of which a return is being earned, the per share comparison is accurate. However, to the extent that new capital comes from retained earnings, a per share comparison gives a false impression of improvement. In such cases the per share comparison is erroneous, as the per share earnings should increase to reflect a reasonable return on the retained earnings invested if the stockholders are to hold their own. Only when such increase is exceeded in the comparison is a true improvement in earnings reflected.

But care should be taken that the consuming public and state and federal regulatory authorities realize that these percentage increases in net income do not reflect higher return on equity investment. If additional equity investment in the electric utility industry were taken into account, the greater portion of the increase would disappear. In other words, the apparent increase represents mostly a return on new money invested and not a higher rate of return on the old investment.

PUBLIC RELATIONS ▶ **Rochester Gas & Electric Corp has just published an 83-page booklet** titled "The RG&E Story." It is written by Arthur P. Kelly. It is dedicated by the company employees to Raymond N. Ball, Fred C. Goodwin, Robert M. Searle, and Herman Russell in recognition of the success of their strategic planning and untiring efforts to achieve independent operation and local control for the company.

Allen-Bradley Line
of MOTOR CONTROL
includes Both!

D.C.

RELAYS AND CONTACTORS

Bulletin 200, Type G Relay. Rated: 5 amp, 64 v; 2 amp, 125 v; 0.5 amp, 250 v.

Bulletin 202 Contactor, Size 2, 1 Pole. Rated: 50 amp, 115-230 v.

D.C. relays are made with up to 8 poles. Also universal types, having contacts changeable from N.O. to N.C.—or vice versa—by merely reconnecting the terminals. Up to and including the 150 ampere rating, D.C. contactors are of the solenoid type; beyond this rating, up to and including 600 amperes, the clapper type construction is used.

ACROSS-THE-LINE STARTERS

Bulletin 600, Form 52, double pole only, open type. Max rating: ¾ hp, 115-230 v.

Bulletin 209, Form 2. Max rating: 1½ hp, 115 v; 2 hp, 230 v.

D.C. manual starters have a rugged, snap action mechanism that prevents contact "teasing" and thus prolongs contact life. D.C. manual and solenoid starters have maintenance free, double break, silver alloy contacts. Motor overload protection is reliable.

A.C.

RELAYS AND CONTACTORS

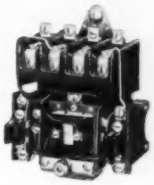
Bulletin 700, Type C. Rated: 10 amp, 550 v max.

Bulletin 702, Size 2, 3 Pole. Rated: 50 amp, 550 v max.

A.C. relays are made in different types for various applications, with up to 8 poles. The universal type, having contacts changeable from N.O. to N.C.—or vice versa—is very popular. The A.C. solenoid contactors, made in 9 ratings up to 900 amp, 550 v max., will satisfy any service requirement. Silver alloy contacts are used throughout the D.C.-A.C. solenoid relay and contactor lines.

ACROSS-THE-LINE STARTERS

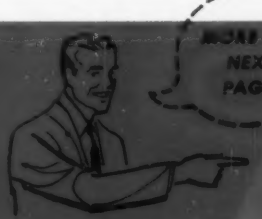
Bulletin 600 in general purpose enclosure, complete with reliable overload breaker. Rated: 1 hp, 110-220 v.



Bulletin 709, Size 1. Rated: 7½ hp, 220 v; 10 hp, 440-550 v. Same general construction for max ratings of 300 hp, 220 v; 600 hp, 440-550 v.

All Allen-Bradley A.C. motor control is equipped with silver alloy contacts which are always in good operating condition. Because all A-B solenoid starters have only one moving part, trouble free performance and long life are automatically assured. It is the basic reason for Allen-Bradley's "quality" reputation.

MORE ON NEXT PAGE!



A-B QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

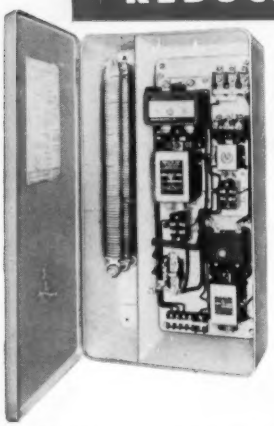
13-57-MR

. . . and more

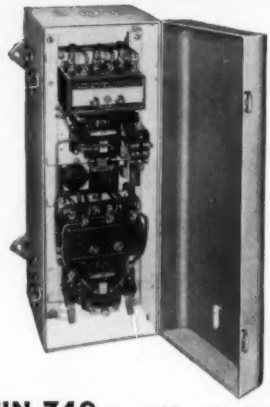
Allen-Bradley MOTOR CONTROL

D.C. | A.C.

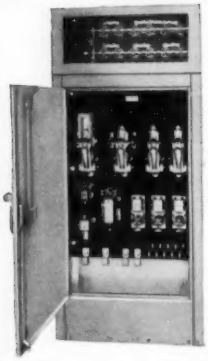
REDUCED VOLTAGE STARTERS



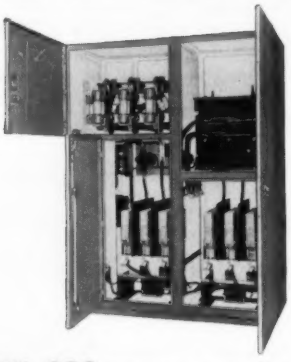
BULLETIN 267 are time limit, resistor type starters for automatic acceleration of constant speed shunt and compound wound D.C. motors. Solenoid contactors used up to and including Size 4 ratings. Max ratings: 75 hp, 115 v; 150 hp, 230 v.



BULLETIN 740 are graphite resistor type starters for automatic acceleration of squirrel cage A.C. motors. Made with 1 or 2 points of acceleration. Can provide velvet smooth acceleration for squirrel cage motors. Max ratings: 200 hp, 220-440-550 v.



BULLETIN 268 are time limit resistor type starters for automatic acceleration of adjustable speed shunt and compound wound D.C. motors. Designed for heavy duty service. Both Bulletin 267 and 268 starters available with or without dynamic braking feature, and also for reversing service. Max ratings: 75 hp, 115 v; 150 hp, 230 v.



BULLETIN 983 high tension starter illustrated above is of the reactor type, intended for starting synchronous motors. Available as an autotransformer reduced voltage starter; also in the across-the-line construction. The heavy duty, solenoid air break contactor assures long, trouble free life. Max ratings: 1500 hp, 2300 v; 2500 hp, 4600 v. at 0.8 P.F.

The Allen-Bradley *quality* line is *not* limited to alternating current motor control. A companion line of direct current motor control is available with the same outstanding *quality* . . . the same reliability . . . the same ability to "take it." Both lines are described and listed in our latest A-B Handy Catalog, and our trained field engineers will also be glad to help you with your control problems.

You cannot make a mistake when you insist on Allen-Bradley control.

A-B QUALITY

ALLEN-BRADLEY

SOLENOID MOTOR CONTROL

QUALITY

Allen-Bradley Co.
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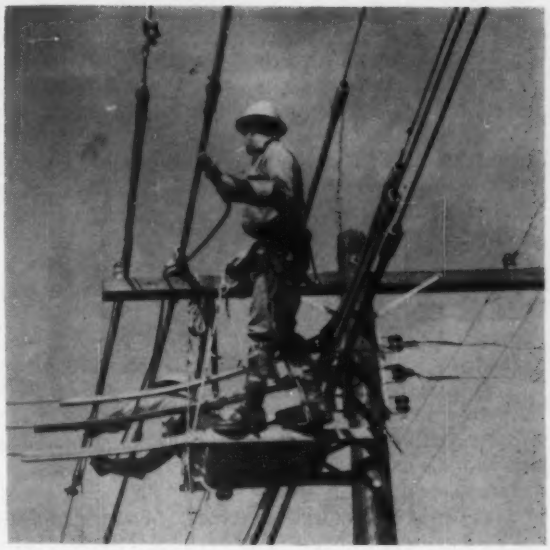
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

13-57-MR

This Pole-Top Scaffold Keeps Linemen Safe



The Keddy pole-top scaffold, developed as an insulating platform for linemen working on poles, is marketed by Roy C. Keddy, Wakefield, Mass.

This scaffold enables a lineman, through assuming a good working position, to perform more with less effort. The platform is away from the pole and serves as a safeguard from the pole's grounding conditions. One end attaches to pole by two special bolts, bored into the pole. Two rope straps support the outer end.

Essentially a hand-crafted article, the shaped oil-treated ash frame with a sand-embedded Fiberglas top, side rails, and bolts which bore into the pole, weighs 26 lb. Compact design makes it easy to carry on a truck. Directions for installation are printed on bottom.

Insulation Makers Vote to Keep EIMA Working Group

Debate over the formation of Electrical Insulating Materials Association as a new organization to serve the electrical insulation field established one point—the need to set up a better two-way flow of information between the makers of insulating materials and the users.

Folowing a full-day session in New York, Dec. 11, a majority of 71 voting representatives of insulation manufacturers decided to continue the EIMA organization committee (EW, Nov. 18, pg 119) as an informal but active group until March 31, 1958. On the basis of this interest, said H. H. Chapman, Jr, chairman protem, the working group will meet early next year to explore ways of cooperating with existing organizations that have an interest in electrical insulation.

Immediate results of this attempt at forming a new group came during the session. K. N. Mathes, vice chairman, Dielectrics Committee of AIEE, said his group has accelerated its efforts to set up the first annual conference on the application of insulating materials. The conference and trade show next fall, to be open to everyone interested in electrical insulation, will be sponsored jointly by AIEE with NEMA and other interested associations.

Mathes also said the National Research Council will prepare a digest of information pertaining to the application of insulating materials. The Conference on Electrical Insulations of the National Research Council reported it has been functioning for some time as a "sounding board" and reference source for data on dielectrics and insulating materials.

These two actions fall within the objective of EIMA—"the dissemination of technical, product, and application information of all electrical insulating materials . . . through national and/or local programs" (conferences, publications, and literature).

The main controversy during the session waxed over whether a new association like EIMA or existing technical societies and organizations could better meet this objective. A majority of the EIMA working group felt existing organizations do not have the means to bring insulation manufacturers into close contact with the users.

Insulation users stated that technical societies do not provide a suitable outlet for papers, discussions, and trade shows because of the societies' primary interest in the theoretical and engineering aspects rather than the commercial applications of insulation. They added there is no place to go for information on insulation applications.

But spokesmen for existing organizations, such as AIEE, ASTM, NEMA, and the Wire & Cable Association, did not agree. They reported that many committees and working groups are functioning in the field of electrical insulation. They felt a group like EIMA would duplicate present efforts, with an increase in time and manpower on the part of the manufacturers and consequent greater expense to the insulation user. ASTM's spokesmen said they are eager to cooperate with technical societies and others to sponsor conferences and trade shows as proposed by EIMA.

DuPont Has Zytel Nylon

Du Pont Co has a tough nylon resin for jacketing wire and cable. "Zytel" 37X is heat and abrasion resistant, with low water absorption.

(*More M & M on page* 190)

Two Utilities Install GE Microwave Systems

Two utilities will soon be operating General Electric Co's high-frequency microwave systems. One system will be battery-operated, first in its frequency range, being installed for South Carolina Electric & Gas Co; the other has a selenium-rectifier power supply, is for Gulf Power Co.

Novel features of the 2,000-Mc band system to be used by South Carolina E&G are a 24-v battery supply and a new type of audio tone, said M. C. Johnson, relay engineer.

This microwave system, will have 16 voice channels initially and will connect McMeekin steam station with the load dispatcher. Seven channels are for telemetering, load and supervisory control, teletype, and protective relaying.

A battery source was designed into the equipment to improve reliability and eliminate auxiliary power sources. The 24-v battery voltage is multiplied in transistorized power supplies to obtain the required 250 to 500 v. Batteries are charged with a 200-amp rectifier.

A new type of transistorized frequency-shift audio-tone was designed for the relaying. The guard tone blocks tripping by directional comparison relaying when a channel is lost.

The audio-tone scheme utilizes pilot wire between the terminals of the microwave equipment and remotely located substations. It also permits more than one channel on a pair of wires.

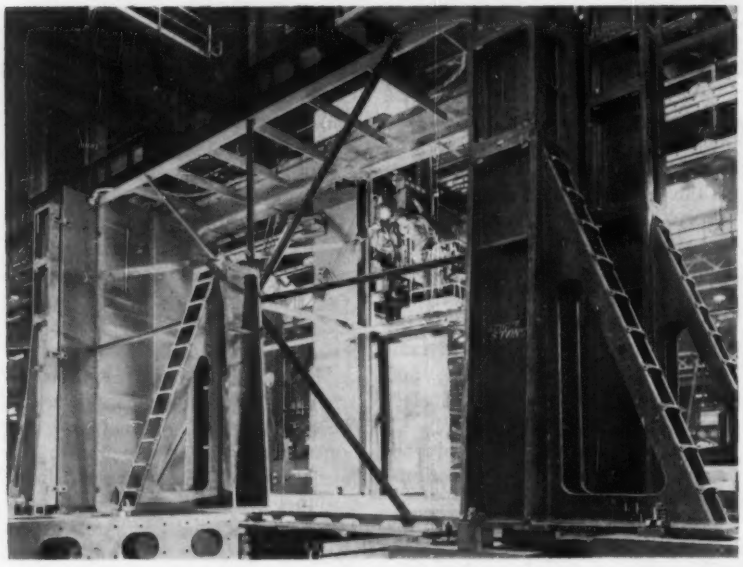
In the system, signals will be sent between McMeekin steam station and the load dispatcher in Columbia, S. C., a distance of 12 miles. At each end is an antenna connected by coaxial cable to the terminal equipment. Between the antennas is a reflector mounted high enough to provide a line-of-sight path. This reflector is on a water tank in Columbia.

For Gulf Power Co, Pensacola, Fla., a high-frequency (2,000 Mc) system will provide central control over a 750-mile transmission network. It is being installed by General Electric Co's Communication Products Department. Power supply is a 115-v a-c selenium rectifier.

This Quadriphase system will include seven voice channels and seven supervisory control circuits for initial operations. Channels are provided for future expansion.

Continuous information on electric power requirements and voltages at key locations will be fed to the power company's load dispatcher via radio impulses transmitted over the control circuits.

The system pinpoints the location of trouble instantly when interruptions in service occur and enables the dispatcher to re-route the flow of power until crews can make the repairs.



A-C Fabricates 200,000-Sq Ft Condenser

Flanges on a shell section of a condenser are being machined on a 7-in. boring bar in Allis-Chalmers Mfg Co shops. This condenser is reported by the manufacturer to be the largest to date in a single shell.

The 200,000-sq ft single-pass condenser will have 21,960 tubes 40-ft long. It will be used with a 325-Mw close-coupled, cross-compound steam turbine-generator. The condenser and the generating unit, also being manufactured by Allis-Chalmers, are for Commonwealth Edison Co's Unit No. 19 in Fisk Station, Chicago.

Spain Installs Largest H-Cooled Syn-Condenser

A 70,000-kva synchronous condenser has been installed at La Mudarra substation of the Empresa Nacional de Electricidad, Madrid, Spain. According to the manufacturer, Secheron Works Co, Geneva, Switzerland, the machine is the largest Swiss-built and the first hydrogen-cooled unit in Europe.

The synchronous condenser and associated transformers are at a major 200-kv transmission line junction between the Northern power generating areas and the Madrid and Bilbao load areas. The unit was designed to insure the stability of several transmission lines of 200 to 300 km each, improve the power factor, and regulate voltage at the connecting point.

The machine has its normal rat-

(*Continued on page* 92)

Contact speed and burning are directly related — excessive burning of contacts will occur with either too slow or *too rapid* contact break. The former delays arc extinction, the latter frequently causes flashover between stationary contacts. Exclusive Westinghouse direct-drive General gear mechanism consistently assures optimum speed. Result . . . arc extinction at first current zero — no flashover, minimum burning.
Westinghouse announces
20-year contact life warranty
For URS tap-changing mechanism . . . regardless of number of operations
Field inspections of scores of URS tap-changing mechanisms, in service 8 years or more, show negligible contact wear and burning. Based on this proved performance, Westinghouse now offers a 20-year prorated warranty on contact life — *regardless of number of operations!*
Load tap changers are direct
action assures optimum
prevent burning.
is not

This Customer's Ad Tells the Mallory Story . . .

Mallory Elkonite®-3W3, a superior grade contact alloy especially suited for heavy duty service, helped make this important plus-service possible. Elkonite is one of many contact materials pioneered by Mallory for the electrical equipment manufacturing industry.

For contact metals, or for contact design, do as many manufacturers have done—call on Mallory, specialists in contact metallurgy, for *complete* assistance, from materials selection to contact design and production. Write, or call the nearby Mallory representative.

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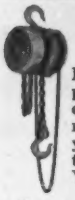
WRIGHT SAFEWAYS
Your Best Buy for Rigging and Maintenance Work



12 Sizes
½-ton to 50 tons

Bulletin 412A gives complete details on the many outstanding features that make Wright Safeways your best buy for long, trouble-free life. Write York, Pa. for your copy.

Some Safeway Features

Load Chain is finest alloy, every foot proof-tested... heat treated for hard wear-resistant working surface... ductile to withstand shock loads... "wick" lubricated... anti-rust zinc coat.

Load and Idler Sheaves rotate on life-lubricated, antifriction bearings... minimum of 5 pockets in Big Sheaves for efficiency and long life.

Gears, Pinions, Drive Spindle (also top and bottom Hooks) are nickel-chrome-molybdenum alloy steel mounted on heavy-duty, antifriction bearings. *Gear Train* is enclosed in oil-tight chamber.

Load Brake is Weston type, silent, dependable.

Steel Housing fully protects vulnerable parts.

ACCO

Wright Hoist Division
AMERICAN CHAIN & CABLE
York, Pa., Bridgeport, Conn.

H-Cooled Sun Condenser

(*Continued from page* 90)

ing at 30 psi H_2, 1.0 pf, 11 kv, 3 phase, 50 cps, 750 rpm. It is 30 ft long, 13-ft in diam, and weighs 175 tons. Installation includes equipment for starting, synchronizing, and stopping.

Transoceanic Cable Book Issued by Simplex W & C

The romance of ocean telephone cables is traced in a book, entitled "Transoceonics," issued by Simplex Wire & Cable Co.

The book relates the efforts of transatlantic communication by pioneers, including the father of Everett Morss, present Simplex president. It also describes the role of Simplex since the production of its first insulated cable in 1885.

Installations are listed from 1900 when Simplex celebrated the completion of what was then the longest (over five miles) underwater telephone cable in the United States—laid in Lake Michigan. In September 1956 telephone communication was established by submarine cable with built-in electronic amplifiers, connecting the U. S. with England, later with Alaska and Hawaiian Islands. Since 1950 the company has manufactured more than 40-million ft of ocean telephone cable.

The 32-page, 8½ by 11-in. illustrated book may be obtained by sending the request on your company letterhead to Public Relations Dept, Simplex Wire & Cable Co, 79 Sydney St, Cambridge 39, Mass.

Hubbard Research Center to Include Outdoor Testing

Hubbard & Co's planned $1-million research and development center will be an integrated facility on a seven-acre site in the Chicago area. In addition to provisions for impulse, surge, and high-voltage testing (EW, Sept. 2, 1957, p 168), the facilities will include:

High power testing will be conducted at a specially designed substation adjacent to the main building. Power will be available to supply test currents as high as 20,000 amp at various distribution voltages. Tests will be controlled at the substation or within the building at a master control station. Closed-circuit television will provide observation of the tests.

An outdoor area will be available for erection of pole lines, distribution structures, and pole line hardware assemblies under operating conditions. Full-scale structure strength tests will be possible. Sections of power and communication lines will also be erected for test and demonstration.

M & M BRIEFS

Allis-Chalmers Mfg Co, Milwaukee, Wis, is supplying the St. Lawrence Power Project with eight 85,000-hp hydraulic turbines and twin oil-pressure governors. Sixteen generators will operate on the American side.

Anaconda Wire & Cable Co has a license agreement with Western Electric Co to manufacture telephone cable designated Alpeth (ALuminum shield, PolyETHylene jacket) and Stalpeth (STeel tape, ALuminum shield, PolyETHylene jacket).

Magnesia-Silica Insulation Manufacturers Association is the new name for the Magnesia Insulation Manufacturers Association. The name was changed because the Association has broadened its interests to include 85% magnesia, calcium silicate, expanded silica, and diatomaceous silica insulations for hot piping and equipment. Headquarters remains at 1317 F St, N.W., Washington 4, D. C.

Delco-Remy Div of General Motors has paid its employees $1 million for suggestions on improving plant operations since GM launched its Employee Suggestion Plan in 1942. W. L. Wasson, an inspector at one of the 10 Delco-Remy plants in Anderson, Ind., received $663.66 for the idea that cracked the million mark.

CATALOGS–BULLETINS

• **HEAVY-DUTY DRILLS:** A 4-p folder features Thor Power Tool Co's reversible, portable electric drills up to 1-in. size. (EW-1226)

• **TURBINE-GENERATORS:** A 54-p bulletin on General Electric Co medium-capacity steam turbine-generator units describes several types used by utilities and industry. It includes 7 pages on governing. (EW-1227)

• **X-RAY INSTRUMENTS:** Instruments Div, Philips Electronics, Inc, offers a 12-p booklet with engineering data on Norelco X-ray instruments for element analysis and structure determinations. (EW-1228)

• **CONTROL SWITCHES:** Instrument and control switches for use with circuit breakers, transformer tap changers, motor-operated rheostats, and other controlled apparatus are covered in Allis-Chalmers Mfg Co's 8-p bulletin. (EW-1229)

• **SYNCHRONOUS GENERATORS:** Hydraulic-turbine-driven synchronous generators are the subject of a 24-p brochure from Elliott Co. Two vertical types are described and illustrated with photos and diagrams. (EW-1230)

• **INDUSTRIAL RECTIFIERS:** Selenium, germanium, and silicon rectifiers for cathodic protection, battery charging, magnetic chuck and d-c motor control are outlined in a 4-p brochure from Rapid Electric Co. (EW-1231)

• **VALVES & CONTROLS:** Automatic Switch Co has published condensed information on solenoid valves and electromagnetic controls in a 4-p brochure. (EW-1232)

• **ANTENNAS & TOWERS:** A 39-p catalog provides data and pictures of two-way mobile radio antennas, accessories, and towers. Communication Products Co, Inc. (EW-1233)

Pictured (left to right) Alfred Scheer, Shaw, Metz & Dolio electrical engineer; George Nejdl, asst. electrical engineer for Shaw, Metz & Dolio; P. R. Ellingson, plant engineer, Johnson Motors; R. S. Terhune, Nelson sales representative.

NELSON

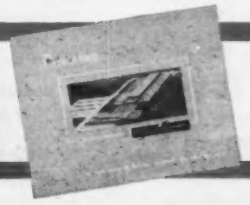
helps make your Johnson outboard motors

Seven Nelson unit substations similar to the one pictured above were used in the new Johnson Motors die cast expansion at Waukegan, Illinois. Each unit, compactly designed for ease of operation and maintenance, controls the flow of power to a section of the plant.

The unit shown is substation No. 3. This is a 1,000 KVA unit, rated 12,000 volt delta primary to 480 volt Wye 277 volt secondary, and incorporating Nelson Class 722 low voltage switchgear. This gear includes 1 — 50,000 AIC main and 8 — 25,000 AIC feeder breakers, and has fully equipped spaces for five additional future feeder breakers.

Thanks to the close cooperation on the part of Shaw, Metz & Dolio, architects and engineers of Chicago, the engineer at Johnson Motors, and the contractor, Aldridge Electric Company with Nelson Electric Manufacturing Company, this installation was made to the *complete satisfaction* of all parties.

When you need any type of electrical control equipment, consult NELSON. The type of team work that made the Johnson Motors installation possible can help you streamline your plant for more efficient operation.



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MEETINGS CALENDAR

JANUARY

International Home Furnishings Market—Including Appliance Show, The Merchandise Mart, Chicago, Illinois, January 6-17.

Edison Electric Institute—Home Service Committee, Chicago, Ill., Jan. 8; 2nd Annual LBE National Women's Conference, Edgewater Beach Hotel, Chicago, Ill., Jan. 9-11; Industrial Relations Committee, Mayflower Hotel, Washington, D. C., Jan. 16-17; Dealer Coordination Committee, EEI Headquarters, New York City, Jan. 30-31.

Instrument Society of America—Boston Section, Yankee Instrument Fair & Symposium, Hotel Bradford, Boston, Mass., Jan. 14-15.

Southeastern Electric Exchange — Personnel Administration Section, Biltmore Hotel, Atlanta, Ga., Jan. 16-17.

New England Farm Electrification Institute—University of Massachusetts, Amherst, Mass., Jan. 22-24.

• **Public Utilities Advertising Association**—Regional Meeting, San Francisco, Calif., Jan. 23-24.

Industrial Heating Equipment Association — Penn-Sheraton Hotel, Pittsburgh, Pa., Jan. 27-28.

American Society of Heating and Air-Conditioning Engineers—64th Annual Meeting, Penn-Sheraton Hotel, Pittsburgh, Pa., Jan. 27-29.

Home Improvement Products Show—Hotel Sherman, Chicago, Ill., Jan. 27-29.

Annual Doble Engineering Clients Conference—Sheraton-Plaza Hotel, Boston, Mass., Jan. 27-31.

• **Pennsylvania Electric Association** — Engineering Section, Prime Movers and Structures & Hydraulic Committees joint meeting, Pocono Manor Inn, Pocono Manor, Pa., Jan. 30-31.

FEBRUARY

National Association of Purchasing Agents—Public Utility Buyers Group Mid-Winter Meeting, Sheraton Hotel, Philadelphia, Pa., Feb. 2-4.

National Rural Electric Cooperative Association—Annual Meeting, Memorial Auditorium, Dallas, Tex., Feb. 2-6.

• **Edison Electric Institute**—Prime Movers Committee, Penn-Sheraton Hotel, Pittsburgh, Pa., Feb. 3-5; Industrial Electrification Heating Conference, Netherland Hilton Hotel, Cincinnati, Ohio, Feb. 3-6; Industrial Power & Heating Group, Netherland Hilton Hotel, Cincinnati, Ohio, Feb. 6-7; EEI-AGA 1958 Conference Final Planning Meetings, Ben Franklin Hotel, Philadelphia, Pa., Feb. 6-7; Electrical Equipment Committee, Dayton Biltmore Hotel, Dayton, Ohio, Feb. 10-11; Transmission & Distribution Committee, Lord Baltimore Hotel, Baltimore, Md., Feb. 11-12; Meter & Service Committee, Sheraton Hotel, Philadelphia, Pa., Feb. 17-19.

Industrial Electrification Council—National Industrial Heating Conference, Netherlands Hilton Hotel, Cincinnati, Ohio, Feb. 3-6.

American Institute of Electrical Engineers—Winter General Meeting, Statler and Sheraton-McAlpin Hotel, New York City, Feb. 3-7.

Missouri Valley Electric Association—Industrial & Commercial Sales Conference, President Hotel, Kansas City, Missouri, Feb. 6-7.

NATIONAL ELECTRICAL WEEK WILL BE OBSERVED FEBRUARY 9-15.

American Public Power Association—Engineering & Workshop Meetings, Chattanooga, Tenn., Feb., 13-14.

National Society of Professional Engineers—Spring Meeting, Michigan State University, East Lansing, Mich., Feb. 13-15.

American Institute of Mining, Metallurgical, and Petroleum Engineers—Annual Meeting, Hotel Statler, New York City, Feb. 16-20.

National Wiring Sales Conference — Statler Hotel, Detroit, Mich., Feb. 20-21.

• **Pennsylvania Electric Association** — System Planning and Transmission & Distribution Committees joint meeting, Penn-Sheraton Hotel, Pittsburgh, Pa., Feb. 20-21; Electrical Equipment Committee Winter Meeting, Hotel Roosevelt, Pittsburgh, Pa., Feb. 27-28.

MARCH

Southern Safety Conference, Inc—Exposition, Peabody Hotel, Memphis, Tenn., March 2-4.

Lighting Lamps and Electrical Manufacturers Salesmen's Association—First National Lighting Exposition, Coliseum, New York City, March 9-12.

Nuclear Congress—Co-sponsored by American Society of Mechanical Engineers and the Engineers Joint Council, International Amphitheater, Chicago, Ill., March 16-22.

National Association of Corrosion Engineers—Annual Conference & Exhibition, Municipal Auditorium, San Francisco, Calif., March 17-21.

American Society of Mechanical Engineers—Management Conference Committee, Hotel Somerset, Boston, Mass., March 19-20.

Edison Electric Institute—Industrial Relations Committee, Headquarters, New York City, March 20; Annual Sales Conference, Edgewater Beach Hotel, Chicago, Ill., March 24-27.

Institute of Radio Engineers—National convention, Waldorf-Astoria Hotel and New York Coliseum, New York City, March 24-27.

American Power Conference—20th Anniversary Meeting, Sherman Hotel, Chicago, Ill., March 26-28.

Southeastern Electric Exchange—Annual Meeting, Boca Raton Hotel and Club, Boca Raton, Fla., March 31-April 2.

• Additions this week.

MORE BIG DATES FOR '58

American Public Power Association—Annual Meeting, New Orleans, May 6-8.

National Association of Purchasing Agents—Annual Convention, Chicago, May 11-14.

Edison Electric Institute—26th Annual Convention, Boston, June 9-12.

American Institute of Electrical Engineers—Summer General Meeting, Buffalo, June 22-27.

National Electrical Manufacturers Association—Annual Meeting, Atlantic City, Nov. 10-14.

HAROLD F. BUTLER

J. LEE RICE, JR

MARION G. MILLER

West Penn Electric Elevates Three Officers

West Penn Electric Co has elected three of its exectuives to positions of greater responsibility. They are Harold F. Butler, who was named to the newly created post of vice chairman of the board; J. Lee Rice, Jr, who rises to president of the company; and Marion G. Miller, who was promoted to the post of vice president.

Earle S. Thompson, formerly president, will continue as chairman of the board of directors and as the chief executive officer of the company.

Butler has been a vice president of West Penn or a predecessor company since 1935. In his new capacity he will continue to be concerned with broad general policy matters. A graduate of Pennsylvania State University and the University of Pennsylvania, he was affiliated with the law firm of Sullivan & Cromwell before beginning his association with West Penn's executive staff in 1935.

Rice, who will now be chief administrative officer of the company, has been a vice president since 1949. He has also been treasurer of the organization. Before joining West Penn in 1944, he had gained public utility management experience with what is now the General Public Utilities Corp. Rice also was graduated from the University of Pennsylvania.

Miller comes to his new vice presidential position from that of assistant vice president, a capacity in which he has served since 1951. A Pennsylvania State University graduate, he has served in a number of capacities since joining the West Penn Electric System 35 years ago. Before being named assistant vice president, he had been assistant controller of West Penn Power Co, a subsidiary, for 12 years.

MP&L Ups Rogers

Mississippi Power & Light Co has elected Alex Rogers as vice president and secretary. Under this new title, he will continue the same duties he has performed since January of 1955, when he was named controller and secretary.

A 23-year MP&L veteran, Rogers has previously been manager of rates and economic research, executive assistant, district manager, assistant division manager, and budget director. He is a member of EEI's Financing & Investor Relations committee.

Parker is New VP

Hugh M. Parker, treasurer for Central Illinois Public Service Co since 1939, will become vice president in charge of finance and secretary of the utility on Jan. 1, 1958. His predecessor, R. B. Tulpin, retires Dec. 31 after approximately 44 years of service with Central Illinois PS.

In other promotions, George R. Cook was made treasurer and assistant secretary and Ralph E. Lindner was elevated to assistant treasurer.

Degen Gets VP Post

Joseph F. Degen has joined the executive staff of Weston Electrical Instrument Corp, a Daystrom subsidiary, as vice president in charge of manufacturing.

Until this appointment, Degen had spent four years as manufacturing superintendent for International Business Machines Corp at its Poughkeepsie (N. Y.) plant.

Anaconda VP's Newlin

New vice president in charge of operations for The Anaconda Co is Richard S. Newlin. He has been vice president of mining operations since 1952.

In simultaneous appointments, T. A. Campbell was made VP-Latin American affairs and C. M. Brinckerhoff was elected executive VP, Andes Copper Mining Co and Chile Exploration Co.

PERSONAL BRIEFS

Homer A. Sager has been appointed manager of Indiana & Michigan Electric Co's 450-Mw Breed plant now under construction . . . American Gas & Electric has named **Morley G. Melden** as editor of its "Monthly Operating Notes."

New secretary of Kansas Power & Light Co is **Clyde E. Dailey,** who was named to replace **I. S. Stewart,** retired.

Charles F. Edwards was named to the new post of general commercial manager of Western Light & Telephone Co, Inc.

Louisville Gas & Electric Co has advanced **John L. Gray** to assistant superintendent, electric distribution dept; **Otto C. Krause** to assistant superintendent, steam production dept; and **J. F. Hurst, Jr,** to plant engineer, Cane Run station.

David N. Stiles has been named farm sales manager of Connecticut Light & Power Co. He succeeds **Walter T. Ackerman,** who has resigned for health reasons.

Recently elevated by Central Hudson Gas & Electric Corp were **Fred P. Jones,** to staff assistant to the vice president-engineering; **William A. Kling,** to electric planning engineer; and **David H. Jackson,** to section engineer of Design Division's electric system section.

In Alabama Power Co's Transmission and Distribution Division, **Leon B. Murray** was made assistant manager, T and D; **Allan R. Barton, Jr,** rose to superintendent of transmission; and **R. T. Garlington** became superintendent of various power operations.

Wilfred E. Page has been elevated to associate engineer in Potomac Electric Power Co's rate dept . . . Duquesne Light Co had named **Paul L. Ambler** superintendent of operations, central district.

Twenty-one electric utility executives are serving on one or more policy development committees for the National Chamber of Commerce of the U. S. Serving on Natural Resources committee are **P. V. Hayden,** Connecticut L&P; **F. G. Irvine,** Utah P&L; **G. L. Jackson,** California Oregon Power; **J. P. Lucas, Jr,** Duke Power; **E. R. Mitchell,** Union LH&P; **T. J. Rouner,** New England Power; and **H. J. Sullivan,** Detroit Edison. On the committee for Commercial Uses of Atomic Energy; **W. L. Cisler,** Detroit Ed; **A. S. King,** Northern States Power; **Philip Sporn,** AG&E Service Corp; **L. M. Smith,** Alabama Power; and **William Webster,** NEES. Business Statistics: **G. E. Schneider,** New Orleans PS. Economic Policy: **R. P. Lee,** Connecticut L&P. Education: **R. I. Brown,** Mississippi P&L; and **L. M. Smith.** Government Expenditures: **R. P. Stacy,** CL&P. Labor Relations: **C. S. Green,** New Orleans PS. Manufacture: **J. J. McDonough,** Georgia Power; **R. B. Roberts,** Florida P&L. Policy: **Harllee Branch, Jr,** Southern Co; **G. M. Gadsby,** Utah P&L. Transportation & Communication: **G. E. Schneider.**

Harry M. Lawson is new manager-marketing for General Electric Co's Medium Steam Turbine, Generator, and Gear Dept . . . At the GE microwave laboratory, **Robert E. Stewart** became manager, technical services.

The Industries Group of Allis Chalmers Manufacturing Co has appointed **R. C. Allen,** director of mechanical engineering, to also direct all consulting services in processing, welding, and other phases of engineering. **W. M. Terry, Jr,** was named director of engineering coordination. The appointments followed retirement of **J. F. Roberts,** director of engineering and A-C vice president . . . **William H. Mutschler** is new chief engineer of the Pittsburgh Works. **George Gallousis** was made patents and standards engineer.

P. M. Christensen has been named coordinator of engineering for Federal Pacific Electric Co.

OBITUARY

F. E. L. Whitesell, former vice president of sales for Burndy Corp and most recently executive director of Electrical Equipment Representatives Assn, died recently at his Winter Park, Fla., home. He had been with Burndy from 1930 until his retirement in 1949.

Report on Power Transformer Operating Practice (*Continued from page* 46)

The distribution of units among systems with various peak loads is given:

How Mobile Units Are Distributed

No. Systems	No. Subs	Peak-Mw
21	1	187-3,000
14	2	99-1,100
5	3	264-1,200
9	4	370-2,500
7	5	310-3,700
3	6	3,750-5,700
2	7	1,250-5,000
1	8	1,300
1	18	2,000

Q: What has been the effect of the availability of mobile power transformers? Allows use of 3-phase instead of single-phase units? Allows use of single-phase banks without spares? No effect? Other?

A: There were 68 system replies; Of those who replied:

- 35 said mobile units allow use of 3-phase transformers
- 27 said mobile units permit single-phase banks without spares
- 6 said use of mobile subs had no effect on their practices.
- 43 mentioned "other benefits", such as the following:
  - 33 said mobile units allow substations to be taken out of service for maintenance, construction, change-over
  - 5 said it reduces installed reserve capacity
  - 7 said they permit faster restoration of service
  - 4 said mobile units defer construction of new substations
  - 3 found mobile subs "permit higher overloads on some transformers"
  - 2 mentioned that mobile units "relieve overloads"
  - 2 that mobile subs "permit use of a single transformer as a first-step"

Q: What sizes and types of mobile substations do you find most useful?

A: The highway type was clearly preferred by 59 of the 64 systems with mobile units who answered this particular question.

The unit size preferred by the largest number of systems (15) was 5,000 kva. But 23 found smaller units more useful; 17 preferred unit sizes smaller than 5,000. It is significant, however, that 31 (53%) of the 59 systems preferred unit sizes in the range from 2,000 to 5,000 kva, inclusive.

Preferred Mobile Unit Sizes

No. Systems	Size-Kva
1	20,000
1	10,000
2	9,375
7	7,500
6	6,000
15	5,000
1	4,500
1	4,000
4	3,750
7	3,000
5	2,500
3	2,000
2	1,500

Q: What is the estimated average annual hours use to date of such mobile power transformers?

A: On hours use of mobile units; 51 systems provided data. 33 either did not answer or said they had no significant records.

Annual Avg Use of Mobile Units

No. Systems	Avg Hr Per Year
27	1,000 or less
11	1,000 to 2,000
8	2,500 to 3,000
3	3,000 to 5,000
1	7,500
1	Continuously

Q: Do you use single-circuit integral-type unit substations on your system?

A: Approximately one out of every two systems uses single-circuit unit substations on its system today. Out of the 40 systems now using such units, 20 plan to use them less frequently, and 14 plan to continue the present extent of use, and four to use them more.

Q: For step-up service in connection with cross-compound turbine generators do you favor: One 3-phase transformer? Two 3-phase transformers? One 3-phase transformer with split low-voltage winding?

A: Answers were limited, apparently due to the fact that relatively few cross-compound units are in use on major systems. But 20 systems are represented. There were:

- 20 favoring one 3-phase unit
- 14 favoring two 3-phase units
- 4 favoring one 3-phase unit with split LV windings

Other arrangements suggested included use of a bank of single-phase transformers with spare; generators connected to one low-voltage bus; a bank of single-phase transformers (no spares were mentioned).

Q: Please state briefly your criteria for scrapping, rather than relocating oil power transformers.

A: The 65 systems answering gave top weight to the following factors: Physical condition (including insulation), age, cost of restoring to condition, high losses, no further need, obsolete size, and failure. Frequency with which these factors were mentioned among the 65 respondents is as follows:

Criteria for Scrapping Units

Mentions	Criteria
18	Physical condition
18	Age
16	Cost of restoring condition
11	High losses
10	No further need
10	Obsolete size
10	Failure
9	Obsolete voltage
6	Poor electrical test

Q: With future transformer developments in mind, give in order of preference your interest in: Easier maintenance, easier installation, greater standardization, lower noise level, lower losses, lower impedance, lighter weight-smaller size, lower price, extension of non-flamable construction to higher ratings.

A: The absolute order of preference among the 78 systems replying follows:

Index	%	Desired Development
567	100	Lower price
440	77.5	Lower noise level
421	74.2	Lower losses
413	72.9	More standardization
388	68.4	Easier maintenance
382	67.4	Lighter weight
296	52.2	Easier installation
132	23.3	Lower impedance
92	16.2	Non-flamable construction

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SALES ASSIGNMENTS

COMPANY STAFFS

Anderson Electric Corp's Underground Fittings Division has named R. S. Mills sales manager . . . John V. Scott is new sales representative for Indiana and Michigan.

Coates Field Service, Inc, has appointed A. Roland Regis as eastern representative. His area covers the New England states, Pennsylvania, Virginia, West Virginia, Delaware, Maryland, New Jersey, Indiana, Illinois, Ohio, and Kentucky.

De Laval Separator Co has named George G. Teren, Jr, as manager of the new district office in Ardmore, Pa.

Enjay Co, Inc, has designated Jack Arnold, Jr, as manager of the Boston office. He will be responsible for the New England area.

General Electric Co's Large Steam Turbine-Generator Department has named Russell W. Miller as manager-sales for Region Four. He will direct activities in the New York, East Central, and Mid-States districts of Apparatus Sales Division . . . Conduit Products Dept has Edward K. How as its new sales manager for standard lines.

Gould-National Batteries, Inc, has designated C. W. Hanna as Chicago regional manager of its Industrial Division. His area includes northern Illinois, Iowa, Wisconsin, North Dakota, South Dakota, Minnesota, and northern Indiana.

Ohio Brass Co has transferred Chicago District Manager Herbert A. Blocki to Minneapolis, to cover upper Michigan, Minnesota, North Dakota, and South Dakota. His Chicago duties will be assumed by Douglas E. Winters. Both appointments are effective Jan 1, 1958.

Philco Corp's Government and Industrial Division has appointed James M. Murray as regional manager of its new Washington (D. C.) regional office for "Transac" sales.

Wagner Electric Corp has named L. E. Long as manager of the San Francisco electrical sales branch.

Westinghouse Electric Corp has designated R. M. Middleton as product sales manager of Standard Control Division at Beaver, Pa. He replaces W. G. Caputo, who was made field sales manager for the Lighting Division, Cleveland . . . John L. Cross is new industrial sales manager for the Atlantic apparatus sales region in Philadelphia . . . Robert J. Pascoe has been advanced to manager of the apparatus sales office at Emeryville, Calif.

Weston Electric Instrument Corp's new Boston district sales office at Wellesley, Mass., is headed by Edward P. Reid. He will be assisted by Edwin O. Brown and F. Lawrence Gosnell.

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U. S. Government

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-5001) will be received at Denver, Colorado, until January 16, 1958, for furnishing one (1) 25,000-kva, 13,800-volt, 3-phase, hydrogen-cooled, outdoor synchronous condenser, with control equipment for Fargo Substation, Missouri River Basin Project, North Dakota. Delivery is desired within 440 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver 2, Colorado. W. A. Dexheimer, Commissioner.

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Public Utility Rate Man—Excellent opportunity with consulting firm. Prefer age 35-45, college graduate with electric and/or gas utility experience. State regulatory commission experience would help. Must possess personality and ability to deal with client customers at top management level. Salary depends upon age, experience, previous earnings and capacity. Job requires travel. Send complete resume with photograph to Robb M. Winsborough, Vice President Middle West Service Company, 20 North Wacker Drive, Chicago 6 Illinois.

Electrical Sales Engineer—Excellent opportunity with firm of consulting management engineers located in Chicago for electrical engineer with some experience in contacting customers, selling through distributors or retailers or contacting or servicing utilities. Will work under direction of a vice president of company of leading electrical appliance and equipment manufacturer accounts. Will also contact top level officials in manufacturing and electric light and power companies. Travel required from fourth to third of the time. Salary depends upon man's age, qualifications, experience and potential. Send resume, with photo if possible, to Robb M. Winsborough, Vice Pres., Middle West Service Co., Consulting Management Engineers, 20 N. Wacker Dr., Chicago 6, Ill.

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NEW!

Check your current transformer installation quickly with this NEW TESCO instrument; pinpoint sources of possible trouble in short-circuiting, faulty connections, instrument tampering, and grounding.

A special new feature now available in this instrument is the spread of resistance burdens — .5, 1, 2 or 4 ohms. The lower burden values are recorded for testing the small size low capacity current transformers, which are widely used on low voltage installations.

2½" panel instrument is easily read. Transparent unbreakable plastic cover. Overall dimensions 6⅞" x 5¼" x 3⅛" high. Weight 2¾ pounds.

EASTERN SPECIALTY CO.
PHILADELPHIA 40, PA.

For full information, write for Bulletin No. 54-B

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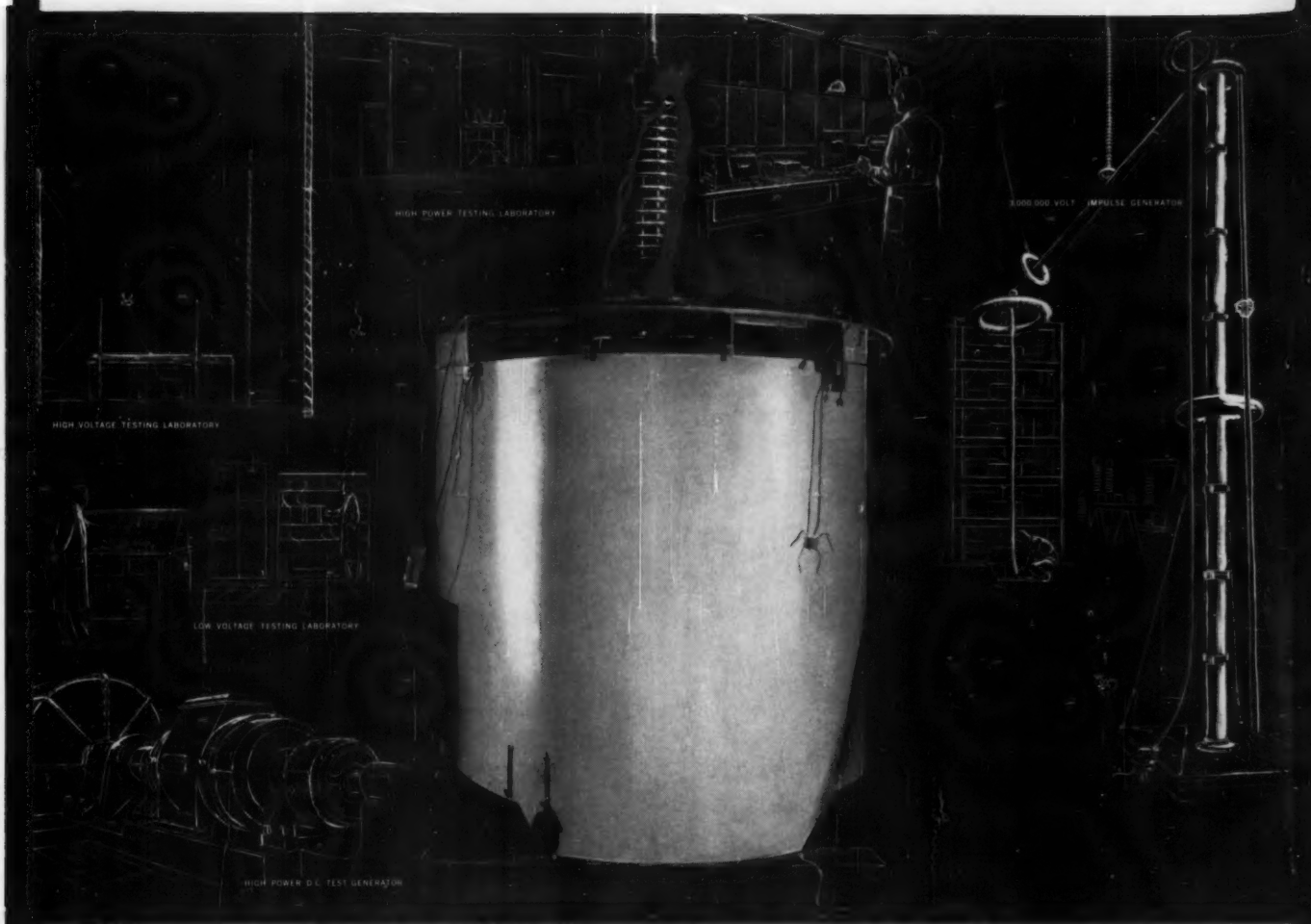
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3,000,000 VOLT IMPULSE GENERATOR
HIGH VOLTAGE TESTING LABORATORY
LOW VOLTAGE TESTING LABORATORY
HIGH POWER D.C. TEST GENERATOR

450,000 volts of man-made lightning flashes over a Federal Pacific 138 KV entrance bushing during performance tests at Palo Alto Development Laboratory.

Federal Pacific Announces RESEARCH FACILITIES FOR SCIENTIFIC PRODUCT DEVELOPMENT

To assure continuous development of the most advanced electrical control and distribution equipment—Federal Pacific has constantly enlarged the scope of its research operations.

Now, the company announces establishment of several new laboratories to further extend investigations into vital areas of electricity. Under more precise analysis than ever before will come the performance problems of high, medium and low voltage apparatus under completely controlled test conditions.

Data obtained at the new Palo Alto, California high voltage installation, for example, will determine design of the oil circuit breakers, disconnect switches, entrance bushings and transformers of the future. The effects—mechanical and electrical—of violent current surges on oil and magnetic-air circuit breakers rated up to 15 kv will be studied at the new Northampton, Pennsylvania high power development station. At Newark, New Jersey, expanded laboratory facilities permit exhaustive testing of such products as bus duct, low voltage circuit breakers, motor control, panelboards and switchboards.

Predictable results: Newer, better, more efficient and economical equipment to control and distribute electricity...developed by Federal Pacific to meet the nation's ever-changing electrical requirements.

FEDERAL PACIFIC ELECTRIC COMPANY
Main offices: 50 Paris Street, Newark 1, New Jersey

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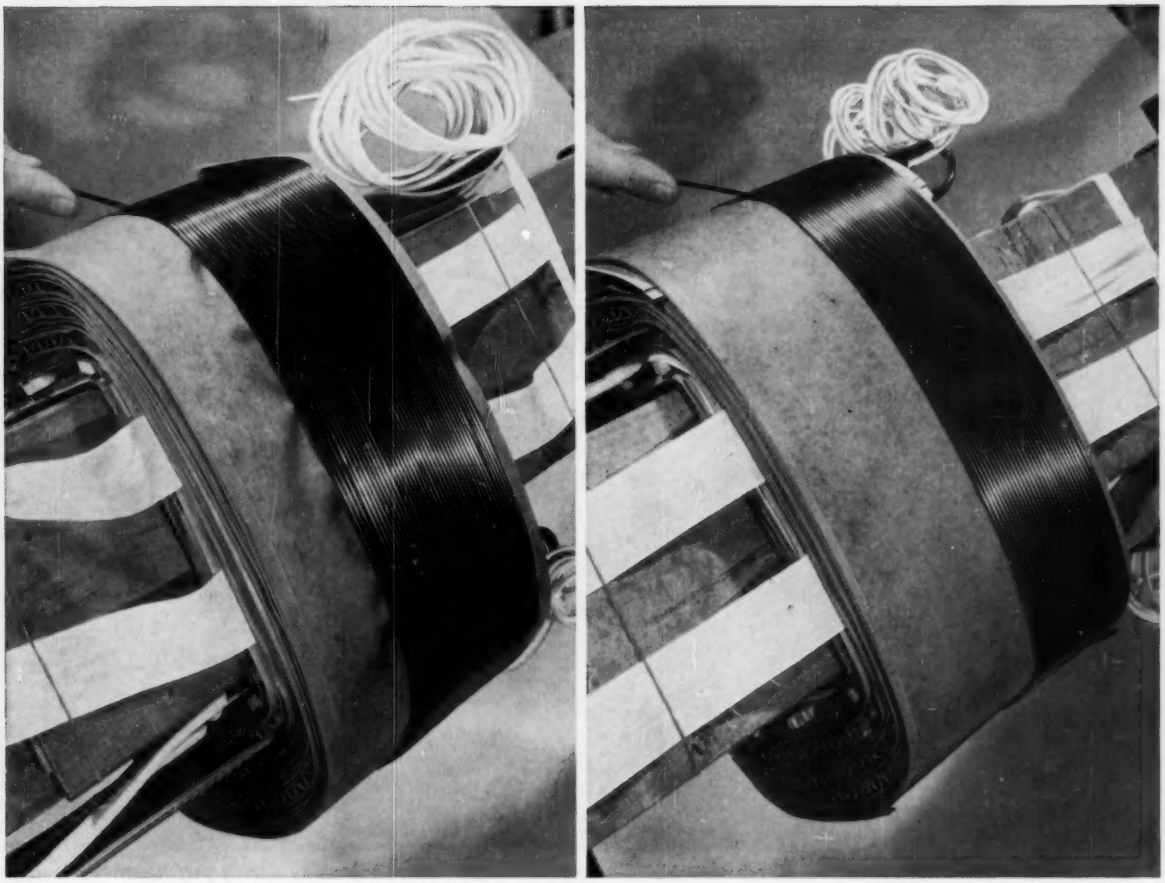
Better Products to Control Electricity



KUHLMAN "Salesman of the Week"

If you can identify this Kuhlman representative, and are the first one to notify Dept. SA-1, Kuhlman Electric Co., Bay City, Mich., you will receive a valuable gift.

"What's different about these transformer coils . . . . ?"

"Although at first glance the two distribution transformer coils shown above may look identical—*there is a significant difference.*

"The coil on the left is being wound with too much wire tension. The pressure on the wire is developing wrinkles or weak spots on the insulation's surface. At the right, the winder demonstrates how a Kuhlman coil is wound so that wire fits snug without crushing the insulation.

"Laboratory tests prove that this difference in coil winding control greatly increases the coil's ability to withstand electrical surges and the harmful effects of aging. Obviously Kuhlman coils offer greater dependability and longer life.

"Here is an example of how Kuhlman research and quality control work together to assure you that when it's made by Kuhlman — *there is a difference.*"

5714D

KUHLMAN ELECTRIC COMPANY

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